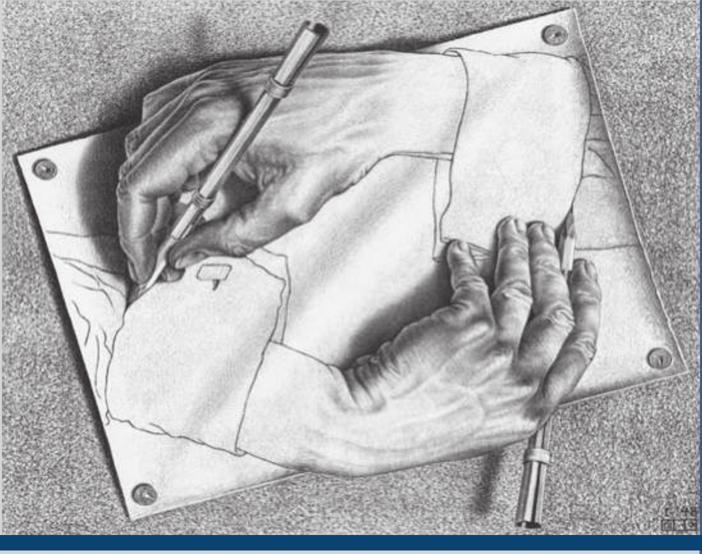

Momme von Sydow

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Universitätsverlag Göttingen

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erschienen im Universitätsverlag Göttingen 2012

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A Historical and Philosophical Analysis of Gene-Darwinism and Universal Darwinism

Universitätsverlag Göttingen
2012

Bibliographische Information der Deutschen Nationalbibliothek

Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliographie; detaillierte bibliographische Daten sind im Internet über <http://dnb.ddb.de> abrufbar.

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Satz und Layout: Momme von Sydow
Umschlaggestaltung: Franziska Lorenz
Titelabbildung: M.C. Escher: Drawing Hands.

http://univerlag.uni-goettingen.de
ISBN: 978-3-86395-006-4

"The progress of biology and psychology has probably been checked by the uncritical assumption of half-truths. If science is not to degenerate into a medley of ad hoc hypotheses, it must become philosophical and must enter into a thorough criticism of its own foundations."

A. N. Whitehead, 1925/1926.

Preface

It is a daring task for a single author to embark on an interdisciplinary inquiry dealing with Darwinism historically, biologically and philosophically; even more so if one finally proposes a critique of assumptions central to current Darwinian paradigms. Interdisciplinary work requires specialized devotion to various fields, merely to gain an overview of pertinent research – be it on the historical person of Darwin or on some current dispute in philosophy of biology. Yet, I consider it a genuine task of philosophy to undertake such broad interdisciplinary investigations. Moreover, the outcome demonstrates that more is at stake than some theories in biology. That is this interdisciplinary study in fact points to a Darwinian metaphysic virtually omnipresent in the *Zeitgeist* at the turn of the millennium. This metaphysics is not influential in biology, epistemology and psychology, but even in politics and economics. Moreover, in this work several lines of arguments are developed providing the basis for a systematic critique of this metaphysics.

Appropriately, my thoughts on the matter underwent a kind of evolution. For this reason I wish to provide a short, somewhat personal account of how I came to my present interdisciplinary interest.

At a point, Sita von Richthoven, a friend of mine, gave me a copy of the book *The Selfish Gene* by Richard Dawkins that I have been engaged with fundamental questions in the field of sociobiology and evolutionary biology – sometimes even in dreams. It was immediately clear to me that this provocative book had a bearing on many philosophical topics; but it was not until later that I realised the book itself warranted philosophical examination. Perhaps it was due to some critical prepartation I had received through the classical writings of Plato, Aristotle, Hegel, and particularly Kant's *Critique of Pure Reason,* that I had been resisting some of tacit assumptions of Darwinian metaphysics und gene-Darwinism. However, over the years the idea of the "selfish gene" did gain futher popularity. In fact, I would concede that this idea did have some positive effects: for instance, it provided a kind of intellectual inoculation against naïve utopias and outdated biological theories of altruism. And yet I think that the idea has proliferated so quickly that critical objections have not received due attention, not just by me but by the scholarly world in general, and hence gene-Darwinism had become a major pest to our intellectual ecology. Although in this last decade the "selfish gene" idea has increasingly had to share the spotlight with other tendencies in biology and even in behavioural economics, what still remains to be worked out is a synthesis of these alternative approaches into a convincing paradigm.

Although a large part of current work in the field is concerned with biological theories of gene-Darwinism and process-Darwinism, such theories do not touch on all areas of Darwinian metaphysics. It was clear to me, having studied philosophy and psychology, that there were structural similarities between the Darwinian process of mutation-and-selection and Thorndike's psychological approach of trial-and-error learning. Moreover, the Darwinian metaphysic is fundamentally connected with philosophical issues linked to Hume's problem of induction. While working on these topics I became increasingly aware that this metaphysic is present in many other subject areas as well, such as the theory of science or of economics. Furthermore, across the globe it seems to have played a crucial role in the neo-liberal policies of unconstrained market-competition and privatisation at the turn of the millennium.

My present work begins with a historical investigation of the background to biological Darwinian paradigms. This background is no irrelevant ornament to the main theme of systematically discussing Darwinism; rather, it provides the basis from which to establish differences between Darwinian paradigms and detect the conceptual core of universal Darwinism. The definition of this core in turn has an incontrovertible impact on the systematic critique of gene-Darwinism, process-Darwinism and Darwinian metaphysics in general.

Although I have done my best to address the different subject-areas, the broad scope of this work nevertheless has the disadvantage of not being able to treat all broached discourses in the depth they deserve. That being said, I still maintain that it would be more unfortunate, if not negligent, to underplay, at the expense of other discourses, the one long argument that acts as the constant thread throughout the book – that is the historically grounded explication and definition of Darwinism and Darwinian metaphysics, enableing a systematic critique of biological as well as metaphysical Darwinism.

In recent years I have worked at the University of Göttingen and now at the University of Heidelberg in psychology in a quite positivistic and technical manner on issues like Bayesian hypothesis-testing. Hence, I am inclined to reconsider this book, based as it is on earlier thought, and I can see that parts of the book are rather speculative. Moreover, I am aware that it could profit from further polishing and updating. This book is based on my PhD thesis in philosophy from 2001 and this edition has only partly been updated and shortened. I have elaborated the section on the problem of induction in more detail in a later PhD thesis in psychology and in my further research, but this later work has not been explicitly concerned with the critique of Darwininian metaphysics, but with logical, statistical and psychological issues. I had the opportunity to keep in touch with recent discussions in evolutionary theory and sociobiology in the Courant Research Centre Evolution of Social Behavior at the University of Göttingen, and therefore I am aware that the book does not account for many of the recent developments in evolutionary biology, sociobiology, and genetics.

Nonetheless, the overall argument of this book still applies. On the one hand, since the time of my earlier work some of its claims – such as the advocacy of multilevel selectionism and the role of evolutionary constraints – have become hotly disputed topics in biology and the philosophy of biology. In this regard I appear to have come closer to the academic mainstream; yet even more daring claims are made in this book. For my ideas challenging Darwinian metaphysics, and in particular Darwinian process-monism, are still innovative, roughly 150 years after *The Origin of Species* first came out. And it may well be that many scholars will find these ideas are too innovative. Nevertheless, I am convinced that the evolution of ideas will go on and eventually question Darwinian process-monism, in biology as well as in other areas dominated by Darwinian metaphysics. Many lessons can and should be learned from Darwinian metaphysics, but I advocate here that such a metaphysic, postulating the inalterable blindness of the evolutionary process, should be replaced by the idea of an evolution of evolutionary mechanisms themselves, with the potential or even the propabilistic inherent tendency to overcome the primordial blindness.

Facts are not at issue; nor is the idea of evolution itself. The crux here is how to interpret evolution. The proposed interpretation of evolution is of course of no minor significance. First, it may contribute to a new framework that may allow for the integration of recent biological developments (concerning, for instance, system-theoretical biology, morphological constraints, Bayesian genetics, and multilevel selection). Moreover, although it cannot be questioned that we can learn very much from Darwinism, it is claimed that Universal Darwinism as an interpretative framework can and should be replaced by an account of the evolution of evolutionary mechanisms – both in biology and in metaphysics.

Momme v. Sydow, Heidelberg, 2011

Acknowledgments

My greatest debt is to the authors – friend and foe alike – whom I have read, and whose texts alone made my further work possible. I should mention especially Richard Dawkins and Daniel Dennett. Their writings inspired me, even if in many respects I ultimately came to different conclusions.

Although I tried mainly to radicalise and then transcend gene-Darwinism and process-Darwinism from within, I of course also owe much to historical and present critics of Darwinism, both paving the way for my argumentation and me confirming me that a different approach was both possible and necessary.

More directly, I am deeply grateful to Professor Dr. David Knight, supervisor of my philosophical (and historical) doctoral thesis on this matter, for his constantly patient, supportive and friendly help. His advice and encouragement helped me substantially, when writing the thesis, in bringing this complex work to a close.

I am indebted to the German *Heinrich-Böll Stiftung,* the *Deutscher Akademischer Austauschdienst* and the *Kölner Gymnasial- und Studienstiftung*, whose scholarships made the work possible.

I gratefully acknowledge the substantial help and critical advice of Peter Bowler, Matthew D. Eddy, Paul Embleton, Mary Midgley, Fiona Pierce, Bill Pollard, Soran Reader, Jennifer Smith, Rob Talbot, and Alistair Wright. Additionally, I want to thank my father, Friedrich v. Sydow, not only for having taught me a love of truth early on, but because he had proof read several parts of the original thesis with his own logical rigour and linguistic sensitivity. Finally, when editing the present revised edition of this work, I received considerable help from Martha Cunningham and Johanna Frisch.

In recent years, I have been concerned with the normative and descriptive models of Bayesian reasoning, providing a wholely different approach to knowledge-acquisition from that of blind (Darwinian) trial-and-error processes. And although the current book does not focus on novel Bayesian approaches within biology, the success of the Bayesian paradigm per se (even if mainly in cognitive psychology) contributed to my confidence in a critique of Darwinian metaphysics in the face of Hume's problem of induction. With this in mind, I would like to express my gratitude to the cognitive psychology lab at Göttingen and to the researchers I met in this sometimes quite technical – but not philosophically irrelevant – field of research. I also want to thank the German Research Foundation for supporting the research on Bayesian models (DFG Sy 111-1, Sy 111-2). When I became affiliated with the Courant Research Centre of the Evolution of Social Behaviour (University of Göttingen), funded by the German Academic Excellence Initiative, I enjoyed the interdisciplinary conferences, such as "Darwin Among the Disciplines," organised by this group. Even more important, I am very grateful to the heterogeneous and interesting group of researchers at the Courant Centre, who have kept me up-to-date with the debates currently operating in the fields of biology and primatology. Although many of these researchers would call themselves Darwinians – perhaps with a different meaning than the one developed here – it can be concluded from this first hand experience that biology is much more diverse and multifaceted than a pure metaphysics of Darwinism or the somewhat narrow popularisations of biological research would suggest.

Finally, personal debts can never be adequately acknowledged; but I want to thank my parents, Anne and Friedrich, and my wife, Sandra, who have provided me with the support, help and love to finish this work.

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Introduction: Nature of Philosophy and Philosophy of Nature

This work proposes and elaborates a philosophy of nature that, although influenced by Darwinism, aims ultimately to transcend Darwinism. My particular focus is on two purified versions of Darwinism: gene-Darwinism (➲ pp. 138 f., 191 f., 215 f.) and process-Darwinism (➲ pp. 205 f.). The essential claims of these two approaches are first explicated and then subjected to criticism. This elaborated critique is not exogeneous to Darwinism, proposing another philosophy of nature from the outset; instead an immanent critique is developed, starting from within the investigated Darwinian paradigms (➲ pp. 243 f.). Focussing on internal inconsistencies of these paradigms, reveals tendencies that will lead us beyond Darwinism.

But not only theories can transcend themselves, the central claim of this work is that Nature, due to inner or outer necessities, continually transcends itself, not only in its products but in its evolutionary mechanisms. As theories are moulded not only by external forces, but by inherent tendencies as well (where the rules of change may sometimes depend on the theory itself), also evolution may depend on evolved evolutionary mechanisms. It is defended that the emergence of new entities and organisational levels may have real causal impact. Hence, in contrast to gene-Darwinism, this work supports a hierarchical theory of evolution. Additionally, the emergence of new evolutionary processes is proposed. Please note, this view needs not to imply a Heraklitian philosophy of nature. Instead it is suggested that evolution and the proposed evolution of evolutionary mechanisms have the potential and even an inherent tendency to overcome blindness (the primordial Darwinian process of blind mutations and external retentions). Emphasising change even of evolutionary mechanisms does not preclude that these changes may refer to or take part in – perhaps even eternal – Platonic forms (*methexis*).

This work started as an investigation into what is called here ‘gene-Darwinism’, challenging its atomism, determinism and process-reductionism. More generally, Darwinian tenets can be found in other sciences as well, such as psychology, economics, and the theory of science itself. Moreover, Darwinism, implicitly or explicitly, has long become a *Weltanschauung* influencing Western culture to the point where it may justify the epithet “universal”. The explication of universal Darwinism led me ultimately to criticise Darwinism in general as incomplete and inconsistent. Although the biological and philosophical applications of Darwinism have undeniably yielded profound insights, Darwinism is closely tied to entity reductionism and process reductionism that are not only grossly simplifying, but, in my view, false. In particular, this work stresses that Darwinism, in its strict formulation, is process-monistic. Correspondingly, Darwinism has sometimes been solely defined by the evolutionary process of natural selection (where, of course, much depends on the definition of natural selection). The process monism at the heart of Darwinism (➲ pp. 102, 142, 216, 358) has at times been concealed by reasonable extensions of the Darwinian paradigm, such as the so-called evolutionary synthesis, often referred to as Darwinian. In other cases, however, a purified, essential form of Darwinism has in fact been clarified, such as in radical gene-Darwinism." Although this paradigm is severely criticised in this work, this paradigm and particular the clarification of the meaning of Darwinism has great merits. In any case, it would be inappropriate to define Darwinism by evolutionary change alone; doing so would mean that biologists in the Romantic Era, advocating an entirely different idea of evolution long before Darwin, would have to be called Darwinians as well. To the contrary, it is argued here that Darwinism – paradoxically still in a Paleyan manner – advocates one eternal law of nature: simple, predetermined and invariant. Despite the evident antagonism today between the two forms of adaptationism – on the one hand, the theological neo-Paleyan religious adaptationism of the creationists, and on the other hand, the radicalised biological adaptationism of gene-Darwinians – there are paradoxically close historical connections between natural theology and natural selection. The new casting of the world as based on evolution did not change the fact that Darwinians conceive the mechanism of evolution as being static, as if it were God given. Like in a Newtonian universe, the laws of nature are taken as being given from the outset; the mechanisms of evolution are taken to be static. Hence, evolution itself does not evolve. These thoughts, with obvious theistic underpinnings, have not only eroded theology, but, even more crucially, in their current gene-Darwinian application to morals they erode other areas essential to the understanding of human life as well.

It is proposed here that this metaphysic should be replaced by a more flexible and truely *evolutionary* picture of evolution. Moreover, it is suggested that evolutionary mechanisms (for instance, due to inner constraints and systemic feedback loops) may gain some autonomy from external determination by (external) selection pressures. Philosophically, however, the emphasis on evolution even of the evolutionary process needs not imply that there is no underlying "Platonic" necessity is involved in the unfolding of nature. Yet, no complete antithesis to biological or philosophical Darwinism is envisaged here, nor a concept of evolution purged of Darwinian tenets. Indeed, much use must be made of originally Darwinian concepts. For example, I take it as given that variational evolution plays an indispensable role in evolutionary theory. Nevertheless, I shall argue that a mono-mechanistic picture, central to the Darwinian paradigm, is inaccurate. The envisioned paradigm shift would indeed casts new light on many biological concepts, but it would also require to incorporate knowledge accumulated in part under the Darwinian paradigm – just as Darwinism incorporated results of originally non-Darwinian Mendelism. Perhaps the question of whether the resulting partly Darwinian view could still be called "Darwinian" is of secondary importance. More crucial is whether one can achieve a paradigm-shift that dismisses the radical substance-reductionism and process-reductionism at the core of traditional Darwinism.

When a philosopher of biology dares to challenge such important biological concepts, the underlying assumption is a specific understanding, both of the philosophy of nature and of the nature of philosophy. In this introduction, first, an account of the advocated *nature of philosophy* and its relation to science is given. What follows is a discussion of some underlying ideas for developing a *philosophy of nature* transcending the Darwinian paradigm. Finally, the "one long argument" of the book is outlined.

The Nature of Philosophy and Its Relation to Science

a) Metaphysics as an Essential Task of Philosophy

Although some forms of metaphysics have been the target of serious philosophical criticism (justified or unjustified), metaphysics per se is both indispensable and inevitable. Both in philosophy and common sense, metaphysics can be ignored, yet will nonetheless be acted upon and reveal itself, if only as a basic underlying tenet. Philosophers objecting to metaphysics generally target a specific traditional metaphysic, but in doing so they often unwittlingly preassume another metaphysics tacitly present in science or current philosophy. Although (particular) metaphysical questions have been increasingly disapproved by a tradition reaching from Hume, over Kant, to positivism and analytic philosophy, this cannot change the fact that the original contexts out of which the authors wrote presupposed a kind of metaphysical basis. It is not objectable to adopt such a metaphysical basis, but to voluntarily or involuntarily obscure such commitment, as seems to be the case in some versions of Darwinian metaphysics.

The progressive philosophical devaluation of metaphysics has many causes and served many understandable purposes. One of Kant's reasons for criticising metaphysics was “to make room for faith”[1], since the only possible metaphysic (in the context of science) was presumably a materialistic or mechanistic one. Kant still managed, however, to reconcile the Newtonian world of matter-in-motion with a strong individually binding ethics. In the case of positivism, the critical emphasis helped to eliminate the endless disputes about first principles and paved the way for a better reception of the sciences. Likewise, analytical philosophy renounced (traditional) metaphysics, but it also castigated some scientific claims as being metaphysical. However, although logical positivism considered itself anti-metaphysical, it has now frequently argued that logical positivism itself introduced a particular metaphysic.[2] In recent decades, some analytic philosophers paradoxically have been explicitly engaged in a rival of metaphysics, while still endeavouring to keep a distance from obscure speculations.[3]

To delve into the problem further, however, it is useful to (re-)examine what today is meant by the term “metaphysics.” The concept is notoriously hard to define, and it may in fact be that a *prima causa* investigation exceeds the scope of scholarly appraisal. Postmodernism has announced ‘the end of metaphysics’ (and of politics and of history). This claim, however, may itself be deconstructed; that is, ironically, the presupposition of a kind of (postmodernist) metaphysics seems to be needed to advocate the impossibility of metaphysics.

In the current context, “metaphysics” is taken to denote the study of the most basic, systematized principles or concepts of philosophy. These principles or concepts may indeed be fragmented and not fully consistent; nonetheless the goal of a more

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[1] I. Kant, *Kritik der reinen Vernunft* (1787/1781), Edition B, p. xxx, ➲ footnote 249.

[2] Such a metaphysics is greatly exemplified by: R. Carnap‘s, *Der Logische Aufbau der Welt.* Cf. H. Putnam, *Reichenbach's Metaphysical Picture* (1991/1996), pp. 100 f.

[3] E.g., J. Lowe, *The Possibility of Metaphysics: Substance, Identity and Time* (1998).

systematic, unified and hence metaphysical understanding remains indispensable. Even if one opposes metaphysics because one wants to favour multiple perspectives or a more domain-specific approach presupposes a particular (pluralist) understanding of truth (or goodness), even this understanding seems to presuppose a metaphysical framework. Such a framework need not be fixed, but rather may evolve over time. Metaphysical approaches, as advocated here, should not degenerate into mere dogmas, but should be open to discussions and further refinements. Correspondingly, I do not commit myself to a particular metaphysical framework at this point. Although even metaphysics, and love of wisdom (*philosophy*) in general, in my opinion, ought to be, at least in part, grounded in fact, such an architectonic approach transcends the merely given. In this respect metaphysics resembles good theories, which go beyond being a mere summary of previous observations. Additionally, metaphysics, could – and should – go beyond particular sciences, to determine and reflect the relationship between them and the traditional philosophical disciplines (logic, epistemology, ontology and ethics).

b) Metaphysics Entrenched in Science

In my view, the traditional critique of philosophical metaphysics left a vacuum that has been partly filled by an implicit or explicit Darwinian metaphysic (despite any other intentions the critics themselves may have had). A large portion of the present work aims at explicating this individualistic (or even sub-individualistic), process-monistic metaphysics. And despite ultimately criticising universal Darwinism, it is suggested here that this position deserves to be called a metaphysic. Universal Darwinism concerns the essence of becoming and claims to mould ontology, epistemology, and logic in a unified way. A version of this metaphysic is often implicitly adopted today, an explicit formulation of which is needed, not least to render it criticisable.

In the positivist tradition, it has often been assumed that science ought to be and mostly is metaphysically neutral and value-free. I naturally uphold the ideal that scientific findings should be inter-subjectively testable instead of, for instance, committed to the idiosyncratic values of a particular group. One needs to keep in mind, however, that scientific findings are not completely free from metaphysical commitment, particularly in the case of fundamental or paradigmatic questions. For example, Max Horkheimer and Theodor W. Adorno elaborated that in fact the seeming neutrality of Enlightenment and science is 'more metaphysical than metaphysics' itself.[4] Alasdair MacIntyre even argues that the seeming neutrality of Enlightenment-metaphysics actually caused an insurmountable obstacle to the formulating of a binding ethics, since it dismissed any teleology from the start.[5] Neverthless, the history of science and the philosophical critique of positivism both revealed a pervasiveness of assumptions that are neither verifiable nor falsifiable.[6] In science it is

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[4] M. Horkheimer, T. W. Adorno, *Dialektik der Aufklärung* (1944/1969), p. 29.

[5] A. MacIntyre, *After Virtue* (1981/2007).

[6] See, for instance, the work of Thomas Kuhn, Imre Lakatos, and the formalization a t-theoretic terms in structuralist accounts of philosophy of science.

of course difficult to disentangle empirical evidence from metaphysics; yet it may be argued that if underlying assumptions are not tested and general in character, they may be termed metaphysical. The disentangling becomes especially problematic for the so-called theoretical core of highly general theories (such as Darwinism) that are often formulated abstractly, using a set of mutually defined theoretical notions.

Even the history of physics (the prototypic science), although clearly based in part on empirical investigation, may be read substantially as the history of metaphysical commitment. Science is theory-laden and, in its more general structure, philosophy-laden. The best scientists and philosophers were metaphysicians as well. It has been argued, for example, that Newton's *Philosophiae Naturalis Principia Mathematica* appears – not just due to the title – to be based on a particular philosophical approach.[7] There are for instance basic philosophical differences between the concept of idealised mass points and modern field-theoretic approaches.[8] As well, Darwin, Dawkins and Dennett are great metaphysicians, whether or not they would welcome the epithet.➲[963] That is, while at times treating gene-Darwinism and process-Darwinism as merely empirically true, they also seem to suggest a conceptual and metaphysical necessity (➲ pp. 207).

When analysing Darwinism, moreover, many questions arise that surprisingly refer to old problems and disputes in philosophy: universals, induction, substance, reduction, explanation, supervenience, form and tautology. In fact the resemblance between some current disputes and disputes in other periods or subject areas may often not be sufficiently known even to philosophers of biology.

c) Science as Philosophy and Art

Biology (and science in general) ought to actively face the challenge that it is actually in part also philosophy or even a *Geisteswissenschaft* and art. Metaphysics, history of science, and ethics all have a role to play in interpreting the findings of science, at least as concerns the fundamental questions of nature.

It is often assumed – I think wrongly – that metaphysics in science has rendered science irrational. In fact, the opposite is the case: it is only the absence of an explicit metaphysic that can render science irrational. In this absence, basic assumptions can be adopted without a rational discussion; thus irrationality indeed often plays a significant role in paradigm-shifts. Likewise, implicitly adopted ideologies are the most dangerous since they can neither be discussed nor criticized. Metaphysics as a discipline alleviates this problem (at least in principle), since it represents an institutionalised attempt to deal rationally with fundamental theoretical questions.

The history of science can render implicit scientific assumptions explicit and can clarify how these assumptions are related to other fields of knowledge. Culture seems to play a crucial but underrated role in science. In philosophy of science, however, for instance methodological culturalism, elaborated by Peter Janich and collegues, has

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[7] G. Böhme, *Philosophische Grundlagen der Newtonschen Mechanik*, in K. Hutter (Ed.), *Ende des Baconschen Zeitalters* (1989/1993). See the excellent doctoral dissertation by K.-N. Ihmig, *Hegels Deutung der Gravitation* (1989).

[8] C. F. v. Weizsäcker, *Aufbau der Physik* (1985), pp. 219 f.

emphasised that the sciences are to be understood as a continuation of the practical understanding of the everyday world.[9] Likewise, within the hermeneutic framework even the sciences have long been taken to be embedded in a particular history with given horizons.[10] Although this work is not based on strict cultural constructivism, it is assumed and argued that the intellectual and cultural history of biology can indeed deepen our insights into current biology (➲ pp. 160 f., pp. 202 f.).

The philosophical discussion of scientific theories should aim at improving consistency, not only within a particular discipline, but between related disciplines as well. For example, if a statement within physics is inconsistent with facts or theories in biology, one may tend to modify the latter, since physics is concerned with a lower ontological stratum and since the most elaborated edifices of theoretical thought are found in physics. And yet there is no *a priori* reason to prefer physics over biology as a means to discover the truth. That is, the physical theory may itself need to be modified if it is inconsistent with biological observations. Likewise, biology has no more priviledged access to truth than has sociology. Overall, it may be said that top-down consistency may be as important as bottom-up consistency; and that, as an epistemic virtue, consistency itself is preferable to reductionism.

At the crux of this discussion, however, is that paradigmatic questions within a particular discipline – like biology – seem to have a bearing on moral beliefs and that sometimes paradigmatic issues are, and I think sometimes 'justly', influenced by ethical considerations as well. This is not to deny that scientific theories (like ethical arguments) obviously have some autonomy. Nonetheless, an inconsistency with ethical conciderations may reasonably for instance lead to an investigation of the adequacy of some theoretical assumptions as well.

Given a context of fundamental scientific issues with relations to ethical or moral questions, it may hence be appropriate to advocate the need of a 'hermeneutics of nature'[11], involving scientific as well as ethical aspects. Thus, perhaps in contrast to the ordinary scientist, philosophers of science and scientists concerned with more general issues carry an additional burden of responsibility for dealing adequately with top-down consistency, sometimes even involving ethical concerns. In a hermeneutics of nature, the empirical and the rational should be coupled with ethical considerations. Only this would yield results based on reason, or, as the ancients called it, *orthos logos*.

d) The Dialogue Between Philosophy and Science

It is not claimed here that the way back to pure metaphysics would be cleared. Just as science deals with metaphysical questions – as in part it should – philosophy in turn

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[9] D. Hartmann, P. Janich (Eds.): *Methodischer Kulturalismus. Zwischen Naturalismus und Postmoderne* (1996). M. Guttmann; D. Hartmann; M. Weingarten; W. Zitterbarth (Eds.), *Kultur – Handlung – Wissenschaft. Für Peter Janich* (2002). M. Gutmann, *Biologie und Lebenswelt* (2005). Cf. the excellent recent doctoral dissertation, Th. Kirchhoff, *Systemauffasungen und biologische Theorien: Zur Herkunft von Individualitätskonzeptionen und ihrer Bedeutung für die Theorie ökologischer Einheite* (2007).

[10] H.-G. Gadamer, *Wahrheit und Methode: Grundzüge einer philosophischen Hermeneutik* (1960/1990), pp. 270 f. See also: M. Heidegger, *Sein und Zeit* (1926/1993).

[11] E.g., F. J. Wetz, *Hermeneutik der Natur – Hermeneutik des Universums* (1995).

ought to consider scientific (empirical) findings. For although methods that abstract from an actual external world (such as counterfactual thinking, thought experiments, generalisation, analogous reasoning, dialectical reasoning, first-person accounts, 'phenomenological reduction', and Socratic debate) legitimate a fair amount of armchair philosophy[12], philosophy has to take seriously the 'facts' of the sciences as well as the phenomena of art and religion.

Although science and philosophy depend on each other, philosophy is not reducible to science, nor is science reducible to philosophy. History of Science can and should help to show that paradigm-shifts in science may sometimes have political underpinnings.[13] Yet it would be dangerous, as well as incorrect, to argue that science *is* politics. Science obviously has its own inner empirical and theoretical approach to truth. And although it has been posited that "[n]othing signaled the emancipation of science from religion and philosophy more definitely than the Darwinian revolution,"[14] this "emancipation," in my view, not only led to progress in biology and liberation from the constrains of religious prejudice, it also ushered in a state of philosophical ignorance. Today the Philosophy of Science, not restricted mere analyses of sense-data or observation-protocols, must carefully treat theories belonging to specific sciences in a broader context than normally done by those sciences themselves. If Darwinism is taken as a metaphysic this suggests that philosophers may contribute something the discussion of the assumptions of this approach and the related systematic philosophical problems. Even knowledge of traditional ontologies of Plato, Aristotle, Thomas Aquinas, Hegel or Whitehead may be highly inspiring for present day discussions as well, although they clearly cannot be simply be recycled for use in the present-day scientific discussion.

It must be said, of course, that philosophical proposals made from the "outside" of a particular science may be proven wrong by empirical or theoretical arguments. Yet after the long period of positivism, it needs to be stressed that scientists themselves may not be the ultimate experts in matters concerning philosophical interpretation. For this reason, I am convinced that philosophy and science should enter into a closer dialogue.

The Philosophy of Nature – Universal Darwinism and Its Transcendence

Although it is argued in this work that nature is to be interpreted partly in philosophical terms, the proposed philosophy of nature does not go so far as to present something like a Aristotelian, neo-Platonian, or Whiteheadian antithesis to Darwinism. Despite being inspired by traditional philosophers and despite obtaining results that may be reminiscent of some philosophical traditions, here an immanent

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[12] Cf. T. Williamson. *Armchair Philosophy, Metaphysical Modality and Counterfactual Thinking* (2005), pp. 1-23.

[13] For the 20th century, take the pertinent examples of the radical race-biology in Nazi Germany and Lyssenko's anti-theoretical Lamarckism in the Sovjet Union under Stalin; today, both cases clearly reveal substantial influences of ideology on science. Rupnow, V. Lipphardt, J. Thiel, & Ch. Wessely (Eds.), *Pseudowissenschaft* (2006).

[14] E. Mayr, *Growth of Biological Thought* (1982), p. 14.

discussion of Darwinian paradigms is pursued. Here in the first place even a Darwinism is proposed purged of all other components in order to deepen and explicate its metaphysical foundation. After all, although biological gene-Darwinism, process-Darwinism, and Universal-Darwinism, point beyond themselves, I believe that it is only after a purging (such as I suggest) that one can emerge from the bottom of the Darwinian abyss and present fruitful alternatives. I do not intend to advocate an antithesis to Darwinism either, a "third way" of conceptualizing the very nature of nature, in which many aspects of Darwinian approaches are included. Despite starting from within the Darwinian paradigm, other biological and philosophical traditions contribute to the envisioned synthesis. The advocated position could in fact be characterized as steering a middle course (1) between atomism and holism (as concerns evolutionary units); and (2) between the unalterable blindness of natural selection and a pre-ordained (omniscient) unfolding of nature (as concerns evolutionary processes). The view that I will propose ultimately goes beyond the (commonly acknowledged) Darwinian concept of a blind, cruel and wasteful law of nature, equally valid for bacteria as for humans. I will advocate that this view needs to be replaced by an understanding of nature that emphasises the evolution of new evolutionary processes.

In the remainder of the Introduction I first relate my investigation to current discussions on today's ecological and economic challenges, followed by a sketch of main topics discussed in the book (with reference to gene-Darwinism, process-Darwinism and Darwinism in general). I conclude with some thoughts on the relationship between Darwinism and religion in light of a more general metaphysic to be developed within the book. Finally, I provide a more detailed outline of the chapters and the one long argument of this book.

a) The Glory and Poverty of Gene-Darwinism – The Need for a Third Way

One goal of this tome is to explicate the paradigm that has dominated sociobiology in its first decades. The central notion of this paradigm is 'the selfish gene' popularised by the gifted writer and biologist Richard Dawkins.[15] Without denying that the contribution of the selfish-gene theory to the development of sociobiology, this paradigm needs to be distinguished from the discipline per se; in particular, since in recent years the theory has in fact come under criticism.[16] In this work the paradigm will later be more strictly defined as 'gene-Darwinism'.

In many respects, gene-Darwinism represents Darwinism in its purest form. "Fundamentally, all that we have a right to expect from our theory is a battleground of replicators, jostling, jockeying, and fighting for a future in the genetic hereafter."[17] First, with regard to the objects of evolution, gene-Darwinism is more radical than the individualist reductionism of Darwin's Darwinism. In biology, gene-Darwinism focuses exclusively on the smallest thinkable potentially evolving unit: single selfish gene. And in opposition to main proponents of the evolutionary syntheis, gene-

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[15] R. Dawkins, *The Selfish Gene* (1976/1989).

[16] E.g., E. O. Wilson, *Kin Selection as the Key to Altruism: Its Rise and Fall* (2005). E. Sober, D. S. Wilson, *Unto Others* (1998).

[17] R. Dawkins*, The Selfish Gene* (1989), p. 256.

Darwinism interprets the Weismann barrier in a way that renders phenotypes mere 'vehicles' of selfish genes. Secondly, with regard to evolutionary processes, gene-Darwinism also provides a more radical version of the original Darwin's process reductionism (which Darwin himself did not carry through) and considers instead the exclusively the simplest conceivable evolutionary process: that of natural selection (blind variation and external elimination): "Anywhere in the universe, is Darwinian selection. [...] Never were so many facts explained by so few assumptions".[18]

In the end, the gene-Darwinian understanding of nature, focusing on selfish genes in a world of unending vicious battle, has been remarkably successful in explaining many aspects of animal and human behaviour (parent-'investment', incest-taboo, the battle of the sexes and sexual bimorphism, the undermining of social-group behaveiour, and so on). Thus a facile condemnation of all aspects of gene-Darwinism is unjustifiable. Hence there is merit in separating wheat from chaff in this theory – which may interest and benefit both gene-Darwinians and their critics.

I argue single genes are indeed the simplest conceivable units of biological evolution. Likewise, natural selection is the simplest conceivable evolutionary mechanism. Nevertheless, it is possible to posit the existence and the causal impact of higher levels of organisation as well as slightly less wasteful mechanisms of evolution. This approach does not require new facts but a reinterpretation of existing ones.

Higher entities, considered in this reinterpretation, are no mere side-effects, but rather essential properties at the core of our ontology. Correspondingly, as concerns the structural necessity of single-gene competition (undoubtedly an important contribution of gene-Darwinism), acknowledgement must be made as well of gene-interactions and larger regulative systems. Exclusive focus on information (the so-called germ-line) must be supplemented by an emphasis on structure and the external determination of meaning for instance coded in genes (what is here call 'exformation'). In other words, the hitherto exclusive focus on competition needs to be balanced by co-operation as an essential (and not epi-phenomenal) aspect of evolution.[19]

Likewise, the central Darwinian idea of an eternally and unrelentingly cruel mechanism that does not evolve must be replaced by the notion of evolutionary mechanisms that themselve unfold creatively. To sum up, in terms of the biology-culture dichotomy, it must be acknowledged that biology has an essential role in enabling culture, and that culture likewise works "top-down" effects on biology (for instance, via partner-choice or what one may call 'moral selection').

As a final comment, the current influence of gene-Darwinism in this sub-field amounts to a final (if Pyrrhic) victory of crude materialist monism, but even gene-Darwinism contains germs to transcend itself. First of all, and quite generally, the one-sidedness of the resulting resuctionism will elicit criticism. More specifically gene-Darwinism has a tendency to shift emphasis from matter to information and thus undermines its own reductionist position. Moreover, although gene-Darwinism is correctly understood as a purified form of Darwinism, it does advocate an "active" nature of selfish genes and this undermines the passive Darwinian view of the

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[18] R. Dawkins, *River Out of Eden* (1995), p. xi.

[19] Cf. J. Bauer, *Prinzip Menschlichkeit: Warum wir von Natur aus kooperieren* (2006).

organism as mere object of external selection. Hence, it will be argued that for such reasons gene-Darwinism will, in philosophical terms, ineluctably transcend itself.

b) A Strict Definition of Darwinism and Process-Darwinism

A spectre is haunting the intellectual world – the spectre of Darwinism. Although Darwin predicted that his theory "would give zest to [...] metaphysics,"[20] even he would be astonished at the breadth of paths his theory has in fact taken – not only as regards gene-Darwinism, but also with regard to process-Darwinism found in many disciplines not obviously linked to biological Darwinism.

Generally speaking, the term 'Darwinism' is usually understood as a biological theory. Nevertheless, processes, operating on different ontological levels, can justifiably be called Darwinian if they are analogous to natural selection. 'Process-Darwinism' denotes approaches that exclusively allow for the existence of Darwinian processes as evolutionary mechanisms or, more generally, as processes of knowledge-acquisition. Both process-Darwinism and gene-Darwinism, I shall argue, exhibit a static process-monism that is closely tied to the deist Newtonian understanding of the world as ruled by a set of simple, basic, eternal and universal laws of nature. A quotation from Darwin's in one of his early notebooks (B) helps to demonstrate the connection between the two 'philosophers':

> "Astronomers might formerly have said that God ordered each planet to move in its particular destiny. – In same manner God orders each animal created with certain form in certain country, but how much more simple, & sublime power let attraction act according to certain laws such are inevitable consequen let animal be created, then by the fixed laws of generation, such will be their successors. – "[21]

That is, like Newton, "Darwin aimed at a theory that is universal and applicable to *all* aspects of *all* living organisms including man and his 'higher faculties.' "[22] This search for a universal law of evolution was influenced by Herschel, Lyell and Paley, who all argued for static or pre-ordained laws of nature. Paley natural theology also influenced Darwin's adaptationism; and, Lyell's uniformitarianism, Darwin's gradualism (➲ pp. 168 f.). Paradoxically the idea of immutable laws in nature (*lex naturalis*) goes back to the originally Platonic-Christian idea of a *machina mundi* (➲ pp. 74 f.)

And although the idea of immutable laws in nature paradoxically goes back to the original Platonic-Christian *machina mundi*, Darwin nevertheless effectively transformed central aspects of the notion's natural theology, producing his own theory of natural selection, replacing the benevolent God-figure with a process of unchanging cruelty and waste.

In any scientific or philosophical pursuit, the act of 'de-fining' (lat. from *de* = down, *finis* = border), of drawing the line between a notion or thesis and its negation is not merely a matter of speaking (a *flatus vocis* in the dispute on universals), but often decides about the very truth of philosophical – and scientific – claims. This

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[20] Ch. Darwin, *Notebook B* (Ed. D. Kohn, 1987), orig. p. 228.

[21] *Ibid*, orig. p. 101.

[22] S. Schweber, *The Wider British Context in Darwin's Theorizing* (1985), pp. 39, 49.

is the clearly case with the term 'Darwinism,' whose meaning, as I have indicated, has not only changed historically, but still no complete consensus on the most adequate definition has been reached. With regard to evolutionary processes, however, natural selection can for historical and systematic reasons be assumed to be the paradigmatic core of Darwinism. One may add, with regard to the objects of evolution, that Darwinism generally takes a reductionist stance (Charles Darwin favoured individual selection over group selection, and modern Darwinians favour individual genes over group of genes).[23] Finally one might add further tenets, to a definition such as gradualism, and, generally a view of life that banishes purpose, direction and spirit.[24] In this work we particularly focus on natural selection (Darwinian process reductionism) and on single genes as evolutionary objects (recent gene-reductionism) which both can be taken to hallmarks of Darwinism. The most uncontroversial and essential definition of Darwinism is based on natural selection.

But even in regard to natural selection one may question, whether Darwinism really tends toward process-monism or whether it allows for a limited process-pluralism. Historically, different positions can be found. Whereas August Weismann purged Darwinism of other aspects, claiming thereby to reveal its true essence, George Romanes emphasised its essentially pluralistic nature. Darwin's own Victorian Darwinism, in fact, was formulated in a guarded way. It was more pluralistic than most Darwinian and non-Darwinian approaches ever since. Darwin himself adopted the straight-forward Lamarckian theory of acquired characters as an integral part of his theory. In a modified way, both Weismann's and Romanes's interpretations can also be found today: Gene-Darwinians such as Dawkins have adopted Weismann's (neo-Darwinian) process-monism as the true paradigmatic core; and several critics of so-called 'ultra-Darwinism,' such as Stephen Jay Gould, have advocated a slightly more pluralistic understanding of Darwinism, embracing other evolutionary factors than natural selection.[25] The example of Gould is worth considering here, for in his recent work, *The Structure of Evolutionary Theory*, he convincingly argued that the Darwinian paradigm can and in fact needs to be substantially altered.[26] And although Gould's position – historicizing process-pluralism – is formulated in a more radical way, I nonetheless agree with the ultra-Darwinians that Darwinism needs to be defined in a strictly idealised way. Also the historical background shows that Darwin searched one universal law of nature. Correspondingly, the core of Darwinism is the idea that the evolution is governed by an immutable law of natural selection (in the broad sense) that includes two sub-processes: blind variation and environmental elimination (natural selection, in the narrow sense).

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[23] Gould, for instance, added a reductive attitude to the units of selection (and gradualism) as further defining features of Darwinism. St. J. Gould, *The Structure of Evolutionary Theory* (2005).

[24] E.g., St. J. Gould, *Ever since Darwin* (1973/1991), pp. 12 f.

[25] *Ibid*, pp. 268 f.

[26] *Idem*, *The Structure of Evolutionary Theory* (2005). Some of my ideas (v. Sydow, 2001) are similar to those elaborated by Gould (who clearly writes in a more elegant prose). Nonetheless, Gould advocates only a reformulation of Darwinism, whereas I posit that the Darwinian metaphysics needs to be transcended. Hence, I would like to carry Gould's work one step further.

If we focus, for our definition of Darwinism, on the process of evolution (and ignore the question of the objects of evolution), several reasons can be provided defining Darwinism as the theory of evolution by natural selection:

(1) Such a definition focuses on what was specific to Darwin's evolutionary theory relative to previous theories of evolution. Undisputively, Darwin's central novel idea was the concept of natural selection. Correspondingly, the title of his originally planned evolutionary magnum opus was '*Natural Selection*'.

(2) Although Darwin still allowed for a degree of pluralism, over time Darwinism came to incorporate the Weismann barrier as well as the strictly blind character of variation; and, in gene-Darwinism, a strict process-reductionism. The use of 'Darwinism' resulting from these changes may be restricted to a more purified theory than Darwin's original version.

(3) Only a strict definition of Darwinism and natural selection will allow us to disentangle the tautological from the falsifiable aspects of Darwinism (➲ pp. 358 f.).

(4) Process-Darwinism and the metaphysics of Darwinism can only be properly understood when linked to the Popperian negative solution to Hume's problem of induction. This negative resolution directly refers to natural selection (blind conjectures and external refutations).

(5) Finally, a strict definition may enhance the conceptual resolution needed to make visible the claimed evolution of evolutionary mechanisms and a potential development from blindness to sight.

On the other hand, however, a broader definition of Darwinism could be adopted, such as: "Darwinism is a theory of evolution in which variation of evolutionary entities (and their survival) plays a role". Under such a definition I would be a Darwinian with regard to biology and even to culture. And in that case this book could not be understood as a critique of 'Darwinism', but only as a claim for a reformulation of Darwinism. In either case, however, the work would still serve as a critique of process-monism, which is here taken to be the core of Darwinism.

In order to discuss evolution by natural selection one needs to determine the meaning of natural selection itself. This term has been characterised variously by: 'the survival of the fittest' (➲ 9.1 a); variational evolution as opposed to synthesis (➲ 9.3 a); blindness of variation (➲ 9.3 b); the externality of natural selection (➲ 9.3 c); and a law of egoistic survival (➲ 9.3 d). All these aspects seem to refer to essential aspects of the process of natural selection in the broad sense, each of them will be submitted to essential criticism in this work. Hence, the resulting philosophical view that I propose – despite huge debts to Darwinism – is clearly critical of a Darwinian view of life and justifies the assertion that we need to go beyond Darwinism, with its stress on an externally-given, unchangeably blind law of nature.

c) From Darwinism to an Evolutionary Theory of Evolution

It is a main aim of this work to help to transcend the static Darwinian understanding of evolution, in order to replace it with a evolutionary understanding of evolution itself. It is argued here that Darwinian process-monism could and should become overcome. Mere natural selection, blind variations and external retention, taken as an epistemic search-process through an astronomically high dimensional property-space appears to be a very inefficient means to find optimal solutions. It is advocated, in fact, that the search-algorithm has changed throughout the course of evolution as well as throughout cognitive and cultural development. I further suggest that the evolutionary processes progressed from its blind, cruel and wasteful beginnings. These processes may become semi-autonomous.

Nevertheless it must be said, in defence of the claimed blindness of Darwinian processes that, in the larger philosophical context, these ideas may indeed help us, for instance, with understanding problems of long-term planning in economics and politics. A metaphysic of radical blindness, however, goes against the (at least partial) predictability presupposed by any concept or ethics of sustainability (concerned with future needs and long-term development).[27] Darwinism is right in its claim that there is a blind aspect to all knowledge-acquisition. But this differs fundamentally from process-Darwinians' metaphysical claim that the blindness inherent in the process of knowledge-acquisition is complete. I stress once more that, rather than an antithesis, what I advocate here is a *third way*. To find such a way (or the golden mean, *aurea mediocritas*) between a purified Darwinism and numerous but not integrated alternative accounts one needs to cull the most useful contributions from conflicting sides. Such a position is advocated both with regard to evolutionary objects, and with regard to evolutionary processes. That is, a transformation of the facts and theories accumulated is needed, just as Fisherian Darwinism of the 1930s and 1940s (➲ pp. 125 f.) historically integrated the anti-Darwinian theory of Mendelism into Darwinism.[28] That is, there is no scarcity of well established theories that could fruitfully be re-interpreted. If Darwin is the 'Newton of a blade of grass' (an expression early coined by Kant), there is nothing to prevent, by extension, the notion of an 'Einstein of a blade of grass' is still needed. The proposal of *an evolution of evolutionary processes* differs considerably from the Darwinian idea of one eternal and universal algorithm (Dennett) of evolution.

Let us take the process of sexual selection as an example that is still very close to the Darwinian paradigm, but that may be interpreted in quite different ways. This process was indeed introduced by Darwin later in his life. But he introduced this process as he was concerned with evolution of man and as he tried to moderate his more radical original position (➲ pp. 112 f.). However, strict process-Darwinism treats this process as an epiphenomenon or a mere short-cut of natural selection. Weismann in his pan-selectionist phase abandoned sexual selection as an own process. Paradoxically, sexual selection – almost totally neglected also by the evolutionary synthesis – reinstated itself as an academic topic under the aegis of gene-Darwinism. It appears inconsistent that this particularly radical form of Darwinism should have introduced some causal pluralism. Indeed closer investigation reveals, as shown in this work, that true gene-Darwinians have understood sexual selection as being reducible

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[27] H. Jonas, *Prinzip Verantwortung* (1978/1984), pp. 37 f.

[28] Interestingly, the main terms used in Darwinism have actually been coined by ardent opponents of Darwinism: 'genetics' by Bateson, 'genotype' by Johannsen and 'adaptive radiation' by Osborn.

to natural selection at the level of single genes. In contrast to this reductionist position it is argued here that one alternatively has to interprete sexual selection as a process in its own right. Although sexual selection is restricted by and based on the 'lower' processes of natural selection, it is here advocated not only to be a mere short-cut of natural selection. Here, sexual selection may well be an adaptation originally evolved by natural selection, but it is a new evolutionary process (of autoselection) with the potential of changing the trajectory of evolution itself. According to this view, there are no purely given *adaptive* landscapes, expressing the fit to an external environment, but rather *evolutionary* landscapes, themselves partly created by the evolutionary process concerned. In particular, it can be argued that sexual selection under certain conditions can retain its direction, even if natural selection "counter-selects," and thus it gains a degree of autonomy from natural selection. Such autonomous tendencies may have led, for example, to the enormous antlers of deer, and may also have played a role in developing tendencies most of us would regard as more positive, such as the evolution of a biological basis of human morals.

Moderation of evolutionary mechanisms in fact can be seen in a variety of areas. Palaeontology and genetics, for example, are full of phenomena that can be understood not just as the product of adaptation based on natural selection, but as the result of new processes that have changed the speed or the course of evolution itself. Similarly, the evolutionary synthesis in the first half of the 20th century provides a treasure-trove of mechanisms that have been largely overlooked by mono-mechanistic gene-Darwinism. We may think, for example, of numerous mechanisms linked to species (sexually interbreeding populations), such as genetic recombination, isolation, genetic drift, founder-effect, and so on. Gene-Darwinism consistently denied the existence or evolutionary relevance of species and sub-populations, in reducing them (and their corresponding mechanisms) to single selfish genes governed by natural selection. In the current work the existence of entities above the level of single selfish genes is advocated. The the 'invention' of species by evolution resulted at the same time in newly emerging evolutionary mechanisms. The evolutionary processes of a species allow an evolutionary line to cross valleys and to reach further peaks on the adaptive landscape. New properties of organisms that have again an evolutionary impact and that were previously inconceivable, such as inner-specific co-operation, could now evolve – and under particular conditions would be very likely to do so.

Furthermore, a criticism of gene-Darwinism need not preclude making use of processes discussed in sociobiology, such as reciprocal altruism. In fact, it is argued here that these processes cannot be fully reduced to gene-selection (➲ p. 39). Taking novel processes seriously, as influencing the course of evolution, means seeing them not just as objects of evolution but also as in part being subjects of evolution.

Although I distinguish evolutionary processes and evolutionary objects for methodological reasons, in this work this distinction is criticised a being ontologically fundamental. Metaphysically, a stance is suggested that resembles a Whiteheadian position, regarding objects as processes and, *vice versa,* processes as objects. Atomistic selfish replicators, the simplest conceivable evolutionary objects, may refer to the pure simplest ('atomistic') evolutionary process of natural selection (➲ p. 218). But species, for example, can be seen not only as objects of evolution, but also, as I have indicated, as evolutionary processes themselves. A particular new species may not imply an as hughe innovation of the evolutionary line, as involved in the 'invention' of the principle of species (involving sexual organisms, a common gene pool etc.). However, also, for instance, changes in the reproductive strategies (e.g., k-selection, systemic selection, gestation periods, reciprocial altruism) should not be understood as being results of evolution, but as changing the evolutionary process as well. Evolutionary innovations like warm-bloodedness or brood care may increase the autonomy of an evolutionary line from its immediate external environment and change the adaptive landscape of this line. Particularly in genetics there are several findings that may well be reinterpreted in the light of an account stressing the evolution of evolutionary mechanisms, but although these ideas need to be elaborated in the future, here it is argued that we may have to take the identity of objects and processes seriously. This would imply that the acceptance of emerging new entities may indeed suggest the new processes as well. The current revival of hierarchical theory of evolution, supported in this work, would allow for several levels of evolutionary organisation gene pools, demes, groups, and so on. It is argued that this needs to be supplemented by an acknowledgment of by a multitude of evolutionary processes. Hence, both fundamental tenets the selfishness of genes and the necessary blindness of evolutionary processes are subject to question.

To apply my Whiteheadian stance to the rehabilitation of phenotyes, then, would necessitate regarding them in a way as being evolutionary processes. Organisms not only evolve according to fixed laws, but they actually constitute a part of the process by which they evolve. That is, body-plans, according to an old tradition in biology[29], may be interpreted to bear certain possibilities or probabilistic tendencies (and constraints) for future evolution, and thus influence the course of evolution. In contrast to gene-Darwinism, this argument holds that phenotypes are not mere vehicles of genes, but evolutionary factors (even if minor). This gives some justice to the old morphological tradition, which long challenged the view that evolution is guided by adaptations to external environment alone rather than being additionally affected by an inner developmental 'logic'.[30]

The theory I present here, then, is that evolution is not only ruled externally and eternally by natural selection, but that evolutionary processes are taken to be at least partly a function of evolution itself (in philosophical parlance, the evolutionary process itself is taken to be not only *natura naturata* but *natura naturans,* ➲ p. 72).

An important question for future research is whether, underlying this theory, one may identify Platonic 'forms', as revealed in evolution and in cultural development. If evolution is understood – on biological and cultural levels – as a process of knowledge-acquisition, then Darwinian processes may indeed and even a priori be the simplest thinkable processes, and in an evolving world it may even be necessary that evolution be able to evolve from blindness to sight.

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[29] G. Webster, B. Goodwin, *Form and Transformation* (1996).

[30] See: S. J. Gould, E. Vrba, *Exaptation – A Missing Term in the Science of Form* (1982/1998). S. J. Gould, *The Structure of Evolutionary Theory* (2005).

The Darwinian focus on the simplest possible explanation of evolutionary change may epitomize an unwarranted application of William Ockham's *via moderna*, which focus has the advantages of a simple explanation; and, of course a simple explanation is preferable to a complicated one. Nonetheless, overemphasising elementary explanations can lead to 'unacceptable simplifications'[31] – so that I must agree with Depew and Weber that in biology a transition from the "sciences of simplicity" to the "science of complexity"[32] is needed (➲ also p. 158). Briefly put, simplicity as concerns Darwinism cannot afford to be simplistic.

In regard of the political implications of the favoured biological approach, steering a middle course between the clean, reduced, simple, and the more complex – or between atomism and holism – would justify neither for an unrestrained laissez-faire economics nor a totalitarian theory that neglects the individual.

Philosophically, there is a fundamental difference between seeing the essence of evolution as, on the one hand, selfish atomic replicators, struggling in an unchangeable, pitiless process of natural selection, and, on the other, the evolution of evolutionary mechanisms, where entities may in part become subjects instead of mere objects of evolution. For one thing, the latter view allows for a reduction of blindness and selfishness on relevant explanatory levels: And perhaps more interestingly, it suggests an active role for the evolutionary subject, as well as the potential improvability of the evolutionary process as it transcends the blind struggle for life.

My work, then, amounts to a manifesto that evolution should be taken more seriously than is done in extant forms of radical Darwinism. Even if Darwin was right in pinpointing that a primordial evolutionary process of blind and wasteful natural selection, still ubiquitous today, there are yet other levels operating, revealing an evolution of evolutionary processes transcending this blind wastefulness and foster the possibility of the autonomy of higher aspirations.

d) The Philosophy of Nature after Times of Ecological and Economic Crisis

We now turn to some more general issues linked to the reception of philosophy of nature. Successful philosophical approaches naturally have to confront the problems of their age. Since at least the 1970s, for example, the need to address ecological problems (partly linked to globalisation) has been apparent.[33] The problems have required not only technical improvements and political laws to restrict environmental pollution, but also suggested a modification of ethics to complement as well as give a foundation to requisite projects.[34] There has been a critique that the *homo oeconomicus* approach, traditionally predominant in economics, is linked to capitalism and egoism, and hence, perhaps, to the exploitation of nature. Such exploitation, in fact, has also

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[31] A. Ch. v. Guttenberg, *Biologie als Weltanschauung* (1967), pp. 25, 35, 51.

[32] D. Depew, B. Weber, *Darwinism Evolving* (1995), p. 18.

[33] E.g., D. L. Meadows et al., *The Limits of Growth* (1972). E. U. v. Weizsäcker, *Erdpolitik* (1989/1990). A. Gore, *Earth in the Balance – Ecology and Human Spirit* (1992). D. Jamieson, *A Companion to Environmental Philosophy* (2003).

[34] E.g., D. Cooper, J. A. Palmer (Eds.), *The Environment in Question: Ethics and Global Issues* (1992). K. S. Shrader-Frechette (Ed.), *Environmental Ethics* (1981/1988).

been identified as the product of mainstream, anthropocentric Judaeo-Christian thinking.[35] It has even been claimed that philosophy in general (including metaphysics, ontology, and especially philosophy of nature) ought to be re-cast as a 'philosophy of ecological crisis'.[36] Despite their many intrinsic differences, philosophers who emphasise the need for an environmental ethics often agree on human responsibility to care for the biological and social environment, to ensure sustainable development, and thereby also to protect future economics in the broadest sense.

Sociobiology, particularly in its gene-Darwinian formulation, seems to provide ideas that directly explain our frequent tendency to exploit environments egoistically. Let us look in more detail, whether or how such an approach relates to ecological thinking. Sociobiology also gained influence during the 1970s and some proponent of sociobiology indeed raised questions concerning biodiversity.[37] In its gene-Darwinian version, however, sociobiology mainly stressed the non-transcendable animal-character of humans and thus presents an explanation for the ruthless exploitation of the Earth, the exponential Malthusian population explosion and the threats to sustainable growth. The result of gene-Darwinism's the sub-individualist stress has somehow been not only a radicalisation of Darwinian individualism, but also its undermining, since the genic continuity with closely related organisms is stressed.

Nonetheless, whereas, on the one hand, gene-Darwinism is reductionistic, stressing the unrestrainable egoism of each selfish gene and denying the causal relevance of any superstructure, on the other hand, ecological ideas in a rather holistic way have emphasized the oneness of the ecosystem, the human responsibility for the whole spaceship Earth and the optimism of cultural changeability as a basis for cultural and ethical reform.

Gene-Darwinians do often regard information about our fundamental egoism to be the only solution – even to the ecological and social crisis.[38] In contrast to this, philosophers of quite different credentials, including supporters of socialist, communitarian, conservative and theological positions (as well as so-called deep ecologists), have advocated the necessity for a "new morality," seeing the crisis as partly the result of 'ruthless application of the atheistic, egoistic materialism' or of 'capitalist veneration of the mammon'. The latter view sees the gene-egoistic paradigm not as a solution to the problem but as one of its causes. Mary Midgley criticized early on this aspect of gene-Darwinism: "In this situation telling people that they are essentially Chicago gangsters is not just false and confused, but monstrously irresponsible"[39] (Cf. Chapter 2, ➲ pp. 41 f.).

All in all, however, pinpointing the antagonistic relationship between gene-Darwinian and ecological thought does not lead us very far. I myself oppose gene-Darwinism because it has gained unbalanced predominance, but I agree that we need to acknowledge the dark side of human nature as well. Nonetheless, we must leave

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[35] See, for example, the L. White debate, ➲ footnote 227)

[36] V. Hösle, *Philosophie der ökologischen Krise* (1991/1994).

[37] E. O. Wilson, *Biophilia* (1984); *The Diversity of Life* (1992).

[38] T. Mohr, *Zwischen genetischer Statik und Dynamik der Lebensbedingungen* (1996).

[39] M. Midgley, *Gene-juggling* (1979), p. 455.

open the possibility for “higher” aspirations as well, and work toward a framework that might acknowledge if not engender them in principle

Lastly, I touch here only briefly on Darwinism and the many crises and downturns that have shaken the fundaments of the global economy. These crises have at times shed doubt on the radical neo-liberal theory of economics – the most dominant school of thought in recent decades, promoting globalization, privatization and deregulation as universal solutions to secure progress. Interestingly, some proponents of laissez-faire capitalism were strongly inspired by Darwinian economics (➲ pp. 191 f., pp. 236 f.). I suspect that the biological and philosophical study of a purged Darwinism and of the evolution of evolutionary mechanisms may well bear fruit in suggesting a crticisim of both a state assumed to be omniscient and a veneration of egoistic pursuits of atomic individuals.

e) Darwinism, Religion and Philosophy

This work is not committed to religion (either per se or in an instiutional form). Nonetheless, it cannot be denied that the view proposed here has implications of importance, not only for enlightened metaphysics, but also for moderate religious stances. That is, in transcending the mere egoistic struggle for life, and vindicating evolutionary subjects from external determination; palatable space may be created for a dialogue that includes not only ethics and metaphysics, but faith as well.

Moreover, a radical, reductionist Darwinian metaphysics of egoistic struggle appears to be inconsistent not only with Christian faith, but with most religions (monotheistic, polytheistic or pantheistic) as well as with most received systems of enlightened ethics. For if on accepts this modification of ethics and religion, this biologization may destroy the core of these two disciplines. This seems to be the case, although evolution itself needs not to be inconsistent with religious beliefs.[40]

In this perspective the essence of Darwinism appears to be neither philosophically nor religiously neutral. This is not to say that the relation between Darwinism and religion is a simple one. And in this respect one may bear in mind that Darwin himself was strongly influenced by Paley’s religious adaptationism and by the deist belief in the existence of universal and eternal laws of nature (➲ pp. 168 f.). Indeed, he had early on even aimed at becoming an Anglican priest, and later he had difficulties – as seen from his notebooks – coming to terms with the materialist and atheist (or agnostic) inclinations of his Malthusian explanation of evolution.[41]

The engagement of Christian religion and what has been called ‘Darwinism’ has been not only multi-faceted but also volatile.[42] Particularly rich examples exist of the clash been science and religion in Victorian days: on the one hand, the oft-cited

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[40] Cf. D. Cooper, *World Philosophies* (1996). D. Sedley, *Creationism and Its Critics in Antiquity* (2007/2009).

[41] J. H. Brooke, *The Relations Between Darwin’s Science and his Religion* (1985). M. v. Sydow, *Charles Darwin: A Christian Undermining Christianity?* (2005). (➲ p. 181 f.)

[42] J. H. Brooke, G. Cantor, *Reconstructing Nature: The Engagement of Science and Religion* (2000). D. M. Knight, *Sience and Spirituality: The Volatile Connection* (2004). D. M. Knight, M. D. Eddy (Eds.), *Science and Beliefs: From Natural Philosophy to Natural Science, 1700-1900* (2005).

anecdote of the encounter between Thomas Henry Huxley and Bishop Samual Wilberforce (son of abolitionist philanthropist William Wilberforce) is normally taken to epitomise the mid-Victorian conflict between science and religion[43]; and on the other, some Victorian 'Darwinians', like the American biologist Asa Gray, who aimed to harmonise Darwinism with religion. But it has to be noted that many of these self-proclaimed Victorian 'Darwinians' were, at least from the present viewpoint, 'pseudo-Darwinians' or Lamarckians.[44] One is at least left unconvinced that these historical examples provide a strong argument against the claim that Darwinism (if defined in a strict way) is incompatible with religion.

Darwin himself, although very cautious and polite in public, was aware that his theory will presubably clash with traditional religion; he even refers to himself as "the Devil's chaplain," using working on "the clumsy, wasteful, blunder law and horrible cruel works of nature," (FN 44). If random variation and external elimination is regarded as the true core of a Darwinian research program, this may be indeed a valid explication of this law of nature, claimed to be immuntable and universal. After Darwin had read Malthus, he scribbled in his notebook: "[…] since the world began, the causes of population & depopulation have been probably as constant as any of the laws of nature with which we are acquainted."[45] Depite not aiming to undermine Christianity, Darwin was led by the logic of his own deductions to introduce something like a rather "diabolic" principle of conservation of cruelty and wastefulness. "To prevent the recurrence of misery, is, alas! Beyond the power of man."[46] This principle indeed served as an antidote against radical utopian ideas about the improvability of mankind that have led to some improvements, but have also caused much harm (the terror and brutality unleashed by the French Revolution, with its original claims to lead the way to a better society, were of course familiar subjects to Malthus and Darwin.

Nonetheless, Darwin, who had political symphathies for the Whigs and who was critical of conservative paternalism as well as of revolutionary radicalism, clearly did not aim to undermine religion. However, involuntarily Darwinism, as world view, turned out to be incoherent with the belief in a benevolent Creator. The chaplain Darwin himself (influenced by another chaplain, Malthus) had actually difficulties to come to terms with these implications of his own biological theory.[47]

Lateron, the Darwinian materialism and biologism played a role in some of the most disastrous developments of the 20th century.[48] And yet there have indeed been ideologically disengaged forms of Darwinism, and clearly Darwinism (in a less strict definition) and religion have coexisted independently of one another. Over the last

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[43] Although Huxley is usually reported to have emerged as the clear winner of this encounter, recently some evidence has been provided that this may have been a founding myth of scientific professionalism. F. A. J. L. James, *An 'Open Clash between Science and the Church'?* (2005).

[44] Cf. P. Bowler, ➲ esp. footnote 404.

[45] Ch. Darwin, *Notebook E* (Ed. D. Kohn, 1987), orig. p. 3.

[46] Th. R. Malthus, *An Essay on the Principle of Population* (1798), p. 98, ➲ also footnote 724.

[47] M. v. Sydow, *Charles Darwin: A Christian Undermining Christianity?* (2005).

[48] R. Nachtwey, *Der Irrweg des Darwinismus* (1959), Kap. 1, 6, 7, 8. A. Ch. v. Guttenberg, *Biologie als Weltanschauung* (1967), e.g., pp. 27, 35, 53.

decades, however, a new wave of radical gene-Darwinism and pure Darwinian metaphysics have pervaded many domains of Western thought, challenging other forms of metaphysics (both secular and religious).

During this latest stage, in fact, Darwinism (and particularly gene-Darwinism), with its rather critical stance towards religion, has become almost a religion in itself. It is worshipped as the "universal solvent"[49]. Darwinian processes have replaced divine processes in the narrative explaining adaptations. Adaptation is often assumed to be ubiquitous, almost in a Paleyan way. Stephen Jay Gould and Richard Lewontin have pointed out that Darwinian adaptive 'explanations' are often *post hoc* "just-so stories". Reminescent of the influence of Paley's and Malthus' theodicy on Darwin, Darwinism may be taken to justify cruelty, not only in nature but in society as well: Alas, isn't the elimination of the weak and wounded a natural necessity? The God of radial Darwinism is in fact grimmer than Descartes' 'deceitful demon;' he is at best a 'blind watchmaker'[50]. In the words of Richard Dawkins: if "there is only one Creator who made the tiger and the lamb, the cheetah and the gazelle, what is He playing at? Is He a sadist who enjoys spectator blood sports?"[51]

Gene-Darwinists have claimed that even human love, sexuality, ethics and religion can in principle be understood in gene-egoist terms.[52] It is aimed not only to explain the evolution of altruism from simple beginnings but to reduce altruism to egoism. This is in sharp contrast to the earlier paradigm in evolutionary biology – the evolutionary synthesis – which had at least left open the possibility of authentic mutual care within species and hence a basis for authentically pursuing a common good. In gene-Darwinism, however, one is left with an egoistic world of struggle beyond improving. In such a world, the "Lord of all Creation" becomes a malevolent or impervious source of evil, devoid of ethics or love, and deaf to the hope that the world could improve in any way whatsoever. This view not only touches the core of Christian faith that "God is love" (1 Johannes 4:16), but also brings into question all Enlightened philosophy as well as the Platonic idea of the Good.

Without abandoning all aspects of Darwinism, which has no doubt proved to be a highly fruitful paradigm, a more optimistic understanding of nature is in fact offered in the idea of an evolution of evolutionary processes. It would be broadly compatible, for instance, with neo-Platonic philosophy, with the idealists'unfolding of nature, and perhaps even with process-theology.

When religous tenets take the form of a Creationist fundamentalism, however, their opposition to Darwinian fundamentalism yields an unfortunate set of basic problems. Thus I present a third way here, which may be palatable to the 'silent majority' of the educated public. Although critical of Darwinian metaphysics, as mentioned above, I clearly do not question evolution per se. The evidence is too

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[49] D. Dennett, *Darwin's Dangerous Idea* (1995), p. 521.

[50] R. Dawkins, *The Blind Watchmaker* (1986).

[51] *Idem*, *River out of Eden* (1995), p. 109.

[52] R. Dawkins, *The God Delusion* (2006). D. C. Dennett, *Breaking the Spell* (2006). Cf. A. McGrath, J. C. McGrath, *The Dawkins Delusion* (2007).

overwhelming.[53] I do argue, however, that the interpretation of evolution itself is yet open to debate. In fact, and rather paradoxically, it is in part the radical reductionism of gene-Darwinism that has provided fuel for launching the theological crusade against ultra-Darwinian metaphysics. It may be conceded that the intelligent-design movement provided a number of noteworthy critical arguments against Darwinism; religiously inspired approaches, with their various metaphysical commitements, may actually help to identify flaws in Darwinian naturalism. Nonetheless, advocates of the intelligent-design movement seem not to have managed to formulate a positive alternative explanation of evolution.[54] Moreover, despite pious intentions, the literalism of many Creationists, as well as their sometimes antediluvian scientific positions, ultimately discredit their religious goal. Interestingly enough, however, radial literalism and ultra-Darwinism may have co-evolved and even supported one another. These antagonistic positions are similar in some respects. Religious literalism resembles naïve materialistic realism concerned with material, or 'given' facts and sense-data, ignoring the importance of interpretation. As a result, although such literalism may be a morally and theologically driven reaction to positivist materialism, it nonetheless works, in its naiveté, to prevent a deeper philosophical or theological understanding that would in fact be necessary to overcome the positivist approach. As a result, despite the fact that science and religion each may be based also on sources of evidence of their own, it is purported here that both need to reflect their premises and in this respect both must become truly philosophical – in effect, a third way.[55]

To sum up, this book provides a discussion of the Darwinian transformation from faith in a universal, eternal divine law into the conviction of a universal, eternal rule of blind variation-and external elimination. The shift of viewpoint produced a somewhat imbalanced metaphysic of unalterable struggle, blindness and wastefulness. What I propose is a more balanced account of the nature of nature in order that social sciences and philosopy may acknowledge more easily the true aspects of Darwinism (and even Dawkinsism). Hence, even to disseminate true aspects of Darwinism, what is required is a move beyond strict Darwinian metaphysics. That is, we must abandon the concept of a static evolution, and develop instead a view that evolution itself is in constant change, an ongoing *creatio continua*, producing entities and processes which have a causal impact in their own right. In turn this permits a theorizing on the

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[53] I not hesitate to agree, in this respect, with R. Dawkins, *The Ancestor's Tale* (2004/2005).

[54] E. Sober. *Evidence and Evolution* (2005).

[55] Even if those Cassandras among the philosophers, like the philosopher Mac Intyre, were right, who advocate that the enlightenment project to formulate a rational ethic were doomed to failure, they demand only a modification of metaphysics, not it abolishment. Philosophical reflection is not necessarily in contradiction with religious belief. For example, the traditions of Kant, Schelling, and Hegel, albeit critical of traditional dogma, aimed to make room for renewed forms of ethics and faith. Although such ideas may have flourished particularly well on Protestant humus, the idea of a *ratio recta* is as old as philosophy itself, and, has not been alien to any of the world's major religions. Pope John Paul II, for instance, in the Encyclica *Fides et Ratio* (1998), § 17, emphasised the role of ratio recta and the necessity of a mutually inspiring dialogue of science and religion.

possibility – if not tendency – to reduce the wastefulness and cruelty evinced in ultra-Darwinism. Such an account of evolution, finally, may pave the way for viable philosophical and perhaps even religious interpretations of nature.

One Long Argument – Outline of the Book

After presenting the advocated conceptions of the nature of philosophy and the philosophy of nature, I will present in detail how my 'one long argument'[56] will be laid out. I am of course aware of the weaknesses of this 'long argument.' I nonetheless publish it, since I am confident that at least some of the ideas and the ultimate message may contribute to the paradigm-shift in the overall philosophy of nature – a step that I think is urgently needed.

Chapter 1 provides a first account of the discipline of sociobiology and its main theories. Even in this early stage of the book it is pointed out that the theories of kin-selection and reciprocal altruism, often treated as direct implications of the selfish-gene view of evolution, need not be linked to a pure version of gene-Darwinism.

Chapter 2 discusses possible ethical implications of gene-Darwinism, since its ontology (implicitly or explicitly) involves the goal of biologicizing ethics. It is argued that the actual ethical proposals by gene-Darwinians, however, make use of other traditions as well. It is shown that even proponents of a selfish-gene view shrink from drawing extreme gene-Darwinian conclusions. This does not present a problem in itself, but it will be seen to point toward the incompleteness of the gene-Darwinian position. In this chapter it is aimed to present a purer version of such an 'ethics'. The latter will then be shown to be ethically unsatisfactory, and therefore to provide justification for further investigation into the the problems and the historical and philosophical background of the paradigm.

Part II of the book has a historical thrust. Beginning with Chapter 3, the general philosophical background of Darwinism is discussed, in which a history of the philosophy of nature provides the context for the idea of eternal laws (related to the notion of a *machina mundi,* a divinely inspired world-machine). Furthermore, pre-Darwinian schools of biology are considered, such as materialist, essentialist and romantic: Understanding these trends of thought can help shed light on today's evolutionary debate. Moreover, an adequate understanding of these may be a necessary prerequisite to defining Darwinism in a historically adequate way.

Chapter 4 continues the historical focus, with a history of the internal workings of Darwinian paradigms. Structural distinctions and similarities between different sub-paradigms are indicated, with reference to Darwin's Darwinism, the two phases of the evolutionary synthesis, and gene-Darwinism. From this discussion will emerge a preliminary working definition of Darwinism based on natural selection. Whereupon it will becomes apparent that these paradigms, often called 'Darwinian,' are far from monolithic. For instance, they have emphasised different units of selection; and they havehave either emphasised Darwinian process-monism or process-pluralism. Yet given that Darwinism is strictly defined, the assumption that the evolutionary

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[56] See Ch. Darwin, *The Origin of Species* (1859), Chapter 14.

synthesis is a thoroughly Darwinian paradigm is open to challenge – not because the evolutionary synthesis has drawn historically from non-Darwinian Mendelism, but because in the 'second phase of the synthesis' (Mayr, Dobzhansky, etc.), an atomistic 'beanbag-genetic' account of evolution has partly been abandoned, replaced by a certain autonomy of populations, macro-evolution, a kind of salutatory speciation, and some causal pluralism. Gene-Darwinism, it contrast, is characterised by gene-atomism, germ-line reductionism, and process-monism. The chapter finally refers to some traditions and recent proposals in micro- and macro-biology are critical of ultra-Darwinism (involving recent multi-level approaches, morphological accounts etc.). It is argued that these account may contribute to a non-Darwinian – or at least a not-*completely*-Darwinian – synthesis.

Following this, Chapter 5 presents the 'external' history of the sketched Darwinian paradigms, discussing their interaction with the respective cultural environments. It will be seen that the paradigms were moulded by particular ideas of the time, as well as by socio-economic influences. With regard to Darwin himself, for instance, several influences are considered: the paradoxical influence of Paley's theological adaptationism; the impact of the Newtonian-Herschelian belief in eternal laws; and the effect of Malthus's ideas on population-growth, harsh conditions for the poor, and laissez-faire economics. In additional, the chapter reveals some historical roots for the similarities between biological Darwinism and broadly Darwinian theories in other subject-areas to be treated in Part III.

Chapter 6 signals the beginning of Part III, in which focus is turned to universal process-Darwinism, which then leads to Darwinian metaphysics, connecting logical, epistemological and ontological concepts. The Darwinian turn in parts of Western philosophy is more profound than generally assumed affecting even subject areas that were in part developed in opposition to biological Darwinism.

This chapter begins with an account of universal process-Darwinism, in which three main points are made. First, that some advocates of process-Darwinism make not only empirical claims, positing the existence of Darwinian processes on several ontological levels, but also metaphysical claims forprocess-Darwinism as universal principle.

The second main point is a proferred philosophical justification for Darwinism as metaphysical approach. That is, knowledge-acquisition lies at the foundation of evolutionary processes, both in the biotic world and in socio-cultural settings. But this understanding recalls the epistemological and logical problem of induction – going back to Hume and further. This problem now becomes equally applicable to such ontological questions. The problem of induction together with Popper's negative 'solution' implies process-Darwinism. Popper's negative solution inevitably involves the denial of induction. Furthermore, if this solution is adopted, the two procedural facets – blindness of trials and externality of selection (defining aspects of process-Darwinism) – necessarily completely account for any process of knowledge acquistion. Consistently, advocates of process-Darwinism have advocated that all processes of knowledge acquisition are reducible to such Darwinian processes. And even the 'knowledge' itself does not truly allow to make justified predictions. If we belief that the sun will rise tomorrow, this claim only has not been falsified in the past, but – according to falsificationism – this provides us with no increased probability whatsoever that the sun will rise in the future as well. Moreover, it follows from such a radical eliminative process-reductionism that the existence of other or 'higher' processes of more rational use of knowledge and more rational ways of knowledge acquisition are not possible or causal, but only apparent.

The third and final point of this chapter concerns objections to these general metaphysical foundations of universal Darwinism. Two Darwinian claims are considered. The first claim is that knowledge-representations (such as a theory or an organism itself) are in principle blind with respect to any new situation, and thus have no predictive value. At the base is a facile tautological truism that new situations by definition cannot be known beforehand. However, this truism, of course, was never the matter under dispute between the Darwinians (or Popperians) and its opponents. The decisive question is whether there could be a rational justification for induction, and the predictive transfer of knowledge from past to present to future. Despite its problems, this second proposition is advocated here. Philosophically, this view denies the premise that the problem of induction can only be solved negatively. An alternative solution to the old fundamental problem of induction is outlined. I advocate – partly elsewere – a knowledge-based use of rational models. This involves the justification of the premisses necessary to for any inductive inference (like the assumption that the nature of the investigated process does not change during the induction) by other inductive inferences. Essentially induction can only take place in a knowledge-based way, in a web of knowledge. Our knowledge is fallible justifies rational beliefs about the future. Knowledge is acquired a posteriori, but the basic standards of rationality are taken to be given a priori, like logic or the probability calculus. (I have discussed this knowledge-based solution of the problem of rational knowledge use and knowledge acquisition in much more detail in another work.[57]) At the end of the chapter we come back to the biological debate, clarifying why the notion of a replicator (genetic or memetic) is logically at the heart of Darwinism.

In the second chapter of this Part III, Chapter 7, local process-Darwinian approaches are considered – that is, those found in particular disciplines. These include the trial-and-error theory of operant conditioning in psychology, Popper's falsificationist approach in philosophy of science, and analogous theories (for example, in immunology and economics). The process-Darwinian claim that all processes (whether general or in a particular subject-area) are Darwinian needs to be distinguished from the actual advocating of the existence of a particular Darwinian process. Some objections to Darwinian processes and process-Darwinism, made by other authors, are sketched. It is notable in this regard that the adaptationism in operant conditioning and falsificationism has been criticised along similar lines as some definitions of natural selection. The tautological interpretation of the survival of the fittest (if fitness is interpreted in terms of survival) resembles the tautological interpretation of the claim that reinforcement increases the probability of the occurance of a behavior (if reinforcement is defined in terms of this this probability). To

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[57] M. von Sydow, *Towards a Flexible Bayesian and Deontic Logic of Testing Descriptive and Prescriptive Rules* (2006).

be clear, one may well argue with respect to operant conditioning that the cognitive turn in psychology has introduced a multitude of processes that replace process-monism. Finally, it is argued that multi-level process-Darwinism is preferable to gene-Darwinism, but it is also pointed out that the former still places too strong an emphasis on both a universal war of entities and the irreducible blindness of evolution.

In Part IV the metaphysics of gene-Darwinism and of process-Darwinism is criticised. In order to do this, a distinction is made between substance- and process-reductionism.

Chapter 8 discusses different types of substance-reductionism at the heart of gene-Darwinism: downward reduction in general, gene-atomism, and germ-line reductionism.

In the first section, it is argued that, for various reasons a thoroughly downward reductionist position is an inadequate and incoherent epistemological or ontological approach. After exploring the difference between the idea of explanation and the idea of downward reduction, the downward reductionist physicalism is criticised partly using insights from physics itself. Then several arguments are presented that it is impossible to explain a property, apparently given on the level of a system, only by referring to its constituent elements and its effects (*causa materialis* and *causa efficiens*), without making use of notions like form, relation or higher-level explanations. Subsequently, it is argued that *biological* reductionism either needs to adopt a principle by which one can stop the reduction at a certain level (like that of single genes) or it ends up in physicalism as well. In the former case, the required principle is identified as the informational notion of a replicator. But it is then argued that this notion is not limited to a particular ontological level. Hence, the argumentation of this section suggests the ontological or epistemological reality of different interacting levels.

In a second section, arguments are presented to counter the claim that gene-atomism necessarily follows from the meiotic shuffle; whereupon a probabilistic understanding of the existence of higher genetic units is developed. In contrast to the gene-Darwinian assumption that atomic genes (relatively short bits of DNA) are the only units of selection possible, here probabilistic higher-level genes are posited. I argue that, under certain conditions, interaction-effects of allele combinations at different loci can be evolutionarily stable. On the basis of the latter, I conclude the fallacy of claiming gene-atomism in a tautological way. If any stretch of DNA that is causally relevant could be defined as a gene (short or long; in one place or distributed over many places of the genome), the claim that only single genes are causally relevant is worthless, as it yields the empty proposition: “only causally relevant genetic units are causally relevant genetic units”. Ironically enough, such tautological arguments may have played a vital role in immunising the gene-atomistic research-program. From the discussion of higher-level genes expressed intra-individually, we turn to emergent genetic properties that may be adaptive inter-individually, being good for a group, a gene-pool or a species. In contrast to gene-Darwinism, a spectrum of different ways is considered, by which the good of a group may be achieved even on a biological level – with and without group selection. What is here called ‘systemic individual selection’ is based on interactive effects of genes at several loci of different organisms. Such a system, normally based on frequency-dependent fitness-curves, may potentially cause a stabilisation of properties that are good for the group. If such properties are generally in place, it is argued, such systems can be stable in the face of egoistic subversion in the absence of group selection. My discussion of group selection in structured populations follows in the wake of E. Sober and D. S. Wilson's basic model, with the added suggestion of how to extend its applicability. Interestingly, the model does not require the wiping-out of whole groups, but rather allows for altruism on the group level. With regard to the selection of whole groups or species, it is pointed out that properties for the good of the group or species may be evolutionarily stable, not requiring a permanent selection of whole groups or species, if a regime of systemic individual selection is in place. This is the case even if only very few events of group selection occur and if these events are not linked. Further to this, ecological wholes may be possible as well, which I will outline. Under specific conditions, by a kind of ecological selection, they also may be stable, resisting subversion of 'selfish' species.

In a third section, I consider another type of substance-reducationism – germ-line reductionism – claiming that phenotypes are mere vehicles of genes. This will be criticized, even though the Weismann barrier is accepted as a working-hypothesis. It is argued that phenotypes (organisms, groups and populations) are based not only on 'information', but also on 'exformation.' Phenotypes, I shall argue, are not reducible to the germ-line, but they constrain or direct the pathways evolution could take. They are thus regarded evolutionary factors as well. Moreover, I shall posit that these structures (or forms) may interact and co-evolve with other morphological structures. In order to justify the common-sense conception that phenotypes are in some sense real, new terminology is proposed to counter the challenge of gene-Darwinism. In this mainly philosophical part, therefore, I will risk introducing some new notions. At first sight, this may appear a bit speculative; however, as intimated above, underlying ideas are needed in order to refute the much more counterintuitive implications of radical germ-line reductionism. These interacting phenotypic structures are treated as probabilistically dependent 'morphological fields' that influence each other. In this context the above term, 'ex-formation' as well as the concept of 'external memory' are introduced. These notions resonate with some aspects of hylemorphism that dominated classical Greek philosophy. Since I shall advocate that the morphology of phenotypes (in its broadest sense) is causally relevant, and that exformation (at least in a certain limited sense) can be stored outside of the informational germ-line of a particular organism, it would be false to consider phenotypes as mere vehicles. Although this argument is developed here for the biological stratum, it holds even more especially for *Homo sapiens sapiens'* second nature – culture.

Chapter 9 concerns Darwinian process-reductionism and its critique. Process monism is taken to be essential to pure gene-Darwinism, process-Darwinism and for Darwinism in general. At the beginning of this important chapter, possible tautological aspects of Darwinism are discussed. In fact, two process-Darwinian tautologies are delineated: one linked with pan-adaptationism and the other with pan-selectionism. If the idea of 'survival of the fittest', if combined with a definition of fitness based on survival, this yields a tautological claim (as alluded to earlier in this Introduction). Such vacuous understandings may implicitly sometimes have acted as an immunization against criticism. Survival of the fittest has often been taken as synonymous to natural selection. Nonetheless, natural selection may be defined in non-tautological way.

I therefore propose a stricter definition of natural selection, purged of all tautological aspects. The definition, as I have already mentioned, is designed to spot changes within the evolutionary mechanism itself. Natural selection is thus strictly defined as a two-step process of blind variation and external elimination. In this one can see a scale of approaches between, on the one hand, the strictly Darwinian pole, interpreting organisms as passive objects to an unchangeable, blind, wasteful, and external law of evolution; and on the other hand, the Lamarckian or Okenian poles, where organisms are active agents of a changing, directed, not-wasteful, unfolding evolution. If these positions represent only two extremes of a broad spectrum of possibilities, it is becomes possible, within that analogy, to counter both of them. This makes clear that there is no necessity to embrace a strictly Lamarckian understanding (which appears largely refuted by biology at least), in order to criticise the claims of a radicalised Darwinian or Dawkinsian understanding of biological and cultural evolution.

Using this stricter, but non-tautological, definition all essential aspects of Darwinism and universal Darwinism will be put to scrutiny in this chapter. The discussion will deal mainly with biological Darwinism, which is more advanced than cultural versions of Darwinism. The sections deal with the claim that (a) epistemological processes are variational, (b) variation is blind and (c) selection (in the narrow sense) is external.

First, arguments are provided that sexual reproduction can be understood in part as a true synthesis. This challenges the view that sexual reproduction is only concerned with variation.

Secondly, the Darwinian tenet of the blindness of variation is challenged. It is argued that one should interpret biological evidence in a way that allows for a kind of directed and adapted process of variation – though this process is of course fallible and not omniscient. Paradoxically, this follows from pursueing a Darwinian approach up to its limits. Darwinism thus again demonstrates that it contains the seeds of its own destruction. A further tentative argument will be that certain kinds of adaptive variation are plausible reactions to specific environments.

Thirdly, it is argued that Darwinism interprets selection ultimately to be external (natural) and an opportunistic response to the moment. This claim is systematically criticised. After refuting a tautological definition of natural selection (in the narrow sense), I shall argue that hetero-selection can be supplemented by 'auto-selection'. It is a claim that comes closer to an active understanding of organisms and a truly 'evolutionary' understanding of phylogenesis than the originally passive, Darwinian understanding of organisms that is taken as being passively adapted to a given environment.

Finally, it is discussed how evolutionary processes may acquire a momentum and 'life' apart from the evolutionary process by which they were generated. Self-referentiality, is considered a possible criterion for the emergence of these new processes (even if based on previously existing ones), with some examination of the problems involved in such a theory.

In Chapter 10, the general principle of entity egoism is briefly discussed. Based on the foregoing investigation, I propose an alternative approach, which I call ‘ecological idealism’.

At the end of this work a more detailed summary is provided, particularly focussing on Part IV.

Part I: Sociobiology and Its Ethical Implications – The Cause of this Investigation

"We do not have a science of nature, we have a science of our descriptions of nature."

W. Heisenberg, 1960.

The notion of sociobiology seems to refer in a fairly neutral manner to an existing *subject matter*, like, for example, biochemistry. Such a subject matter apparently could be defined in several ways. Firstly, it could refer to the science concerned with group behaviour (*socio*) of living beings (*bios*). Secondly, it could refer to the branch of sociology, which tries to contribute to an explanation of human social behaviour by analysing its biological or evolutionary basis. Although it would be preferable to use the term 'biosociology' to refer to the second meaning, to distinguish these two meanings, the actual usage of 'sociobiology' includes biosociology and sociobiology in the narrow sense. Another possible meaning of these terms would be the sociological or cultural study of the intellectual background of biology. This issue is largely neglected in biology itself and consequently not part of the common definition of sociobiology. Here this issue shall be addressed later on (➲ pp. 203). Besides its rather neutral meanings the term 'sociobiology' has sometimes been used to denote a *school of thought*, which at this point might be roughly signified by the selfish-gene point of view.

In Part 1, Chapter 1 is concerned with a provisional biological characterisation of basic aspects of this discipline which were also important in the paradigm and Chapter 2 considers the explicit or implicit ethical inclinations or implications of sociobiology. The part has an introductory character, where we start with sociobiology as it has normally been presented in the early decades after the birth of this discipline. Philosophical discussions are largely excluded. The implications of radical versions of sociobiology are shown to be incoherent with common sense and provide a motive to scrutinise the historical, empirical and logical premisses of these implications more closely. After we will have explored the historical roots of Darwinism, its sub-paradigms, and, in particular the current paradigm of gene-Darwinism, it will become possible to criticise these premisses.

The distinction of a subject area on the one hand and a – philosophically more interesting but more disputable – paradigm on the other hand entails that not all scientists who work in the subject area need to advocate the paradigm. In regard to the biosociological application of sociobiology, especially its application to ethics, the opinions of biologists indeed diverge as widely as the opinions of philosophers do (➲ pp. 41 f., 144 f.). Moreover, although nearly all sociobiologists see the importance of gene-level explanations, a relevant portion of sociobiologists are critical or have become critical of a purely selfish-gene paradigm. I am here going to present only some basic aspects of sociobiology. Later on, I present a more purified paradigm, 'gene-Darwinism' (➲ pp. 138 f.). A strict definition of gene-Darwinism will allow me to argue that the idea of Evolutionarily Stable Strategies may well be inconsistent with this paradigm (➲ p. 39).

Chapter 1:
Sociobiology as Discipline and Paradigm

The impressive tome *Sociobiology, The New Synthesis,* published in 1975 by the known American entomologist Edward O. Wilson, is often regarded as the first comprehensive and eminent manifesto of sociobiology. Earlier Wilson had published important works on eusocial hymenoptera (in particular on ants). In *Sociobiology* he has incorporated concepts like kin selection and reciprocal altruism into a generalised account of animal and human group behaviour.

Wilson has in fact been much more guarded in his biological theory than others following in his wake. But since he had the term 'sociobiology' in a recognised textbook and since he started to promulgate central concepts of sociobiology, he is one of the main founding fathers of sociobiology (as a discipline).

However, Wilson has not advocated the selfish-gene paradigm as wholeheartedly, as some advocates the 'paradigm of sociobiology' which gained dominance in the discipline in its early decades. R. Dawkins has even called Wilson the last advocate of 'the *old* benevolent regime'[58]. Wilson in turn regards Dawkins approach as reductionistic.[59] In my opinion, Wilson's position indeed has to be placed somewhere between Dawkins' radical selfish-gene account and the account of the so-called synthetic theory, focusing on population biology and biogeography (➲ Chapter 4). Wilson seems to have wavered between a more reductionistic[60] and a more holistic view, allowing for the possibility of group selection.[61]. In contrast to Wilson, Richard Dawkins and other spokesmen of the gene-egoistic paradigm have banished that level of selection from the realm of scientific respectability.[62] Interestingly, Wilson explicitly came back to support group-level selection more recently, even with regard to ants and termites, which have been taken to be paradigmatic examples for a gene-Darwinian explanation.[63]

Nevertheless, Wilson clearly has layed down a radical *biosociological* research programme, claiming that sociology should be reduced to biology. This idea has profoundly influenced sociobiology and its reception in the larger public. Because of his claims to 'biologicize' culture and even ethics[64] and the changes in evolutionary

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[58] R. Dawkins, *The Extended Phenotype* (1982/1989), pp. 56, 193.

[59] R. Dawkins, *In Defence of Selfish Genes* (1981), p. 573.

[60] E. O. Wilson, *Sociobiology* (1975), e.g., p. 3. In *On Human Nature* (1995), Wilson rates group selection as a rather unimportant force and, hence, selfishness (of single genes or individuals) as the sole driving force of society, pp. 155-156, 158-159, 164.

[61] E. O. Wilson, *Sociobiology* (1975), e.g., pp. 7, 106-117.

[62] R. Dawkins, *The Selfish Gene* (1976/1989). In *The Extended Phenotype* (1982/1989) he is generally more guarded, pp. 38, 61, 105-106, 108-109, 116, but finally appears to keep up this position, pp. 4, 114-115, 191 f. See also G. C. Williams, *Adaptation and Natural Selection* (1966). E. Voland, *Grundriss der Soziobiologie* (2000).

[63] E. O. Wilson, *Kin Selection as the Key to Altruism: Its Rise and Fall* (2005).

[64] E. O. Wilson, *Sociobiology* (1975), p. 562, ➲ footnote 89.

biology, which he at least co-provoked, sociobiology was soon singled out for criticism (➲ pp. 144 f.). But this challenge to other subject areas also inspired interesting new theories for instance in psychology[65] or in philosophy[66] (➲ pp. 160 ff.).

However, there are several founding fathers of sociobiology. The famous British biologist and popular science author Richard Dawkins[67] is not only the most gifted populariser of sociobiological theories, but he also has been much more marked in his atomistic zeal than Wilson. He became the true metaphysician of this movement (this is truly complementary remark). He was able to distil the gene-Darwinian essence only partly visible in early sociobiology. Whereas Wilson adopted the level of single genes only as an important level of explanation among others, Dawkins in *The Selfish Gene* (1976) indeed radicalised and purified this approach by advocating the selfish-gene view as the one and only type of evolutionary explanation. Many biologists and even more non-biologists reading his popular books have followed in Dawkins' footsteps. Although Dawkins based his writings on empirical findings, he mainly contributed to the development of theoretical interpretations of these finding. This does not diminish his role as leading metaphysician of a particularly reductive approach to evolutionary biology. It was Dawkins who took the step to focus completely on the concepts of the selfish gene and natural selection.[68]

As a third main founding father one may well name the American evolutionary biologist George C. Williams'. In *Adaptation and Natural Selection* (1966), William, previous to Dawkins' *The Selfish Gene,* advertised the idea that group selection could play no significant role in evolution. He clarified that natural selection is the only true mechanism of evolution and that one should not misinterprete this blind process as being truly progressive (cf. his work on antagonistic pleiotropy). *Adaption and Natural Selection* provides a crucial step in the development of a general selfish-gene paradigm, but it lacks the (metaphysical) clarity and radicality of Dawkins' *Selfish Gene*.

Dawkins' and William's selfish-gene approach within evolutionary biology combined with Wilson's uncompromising demand to biologise the social sciences and ethics moulded sociobiology, at least in its first decades. Whether this mixture of ideas is coherent or not, it has become highly influential. Later on I will contrast this 'new synthesis' with the older 'evolutionary synthesis' (➲ pp. 123 f.) and with classical ethology.[69] Of course many more authors played a role in the creation of this new

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[65] E.g., H. Plotkin, *Darwin Machines and the Nature of Knowledge* (1994). J. H. Barkow, L. Cosmides, J. Tooby, *The Adapted Mind* (1992). D. Buss, *Evolutionary Psychology* (2004). But see also: D. C. Penn, Holyoak, K. J., D. J. Povinelli, *Darwin's Mistake: Explaining the Discontinuity Between Human and Nonhuman Minds* (2009). ➲ footnote 890 and ➲ pp. 221 f.

[66] E.g., D. Dennett, *Darwin's Dangerous Idea* (1995).

[67] Until 2008 Dawkins has been Professor for the Public Understanding of Science at the University of Oxford.

[68] Although Dawkins radically advocates gene-reductionism, he paradoxically has expressed a creed of an independence of the cultural – memetic – sphere.[➲188] Interestingly, even the concept of the 'Extended Phenotype' may not only be interpreted as a radicalisation of this paradigm, but in some respects as transcending the replicator-vehicle ideology, see *The Extended Phenotype* (1982/1989), pp. 4 f., 115, 117, Chapter 4, 12, 13. But see also Chapter 3, esp. p. 35.

[69] Cf. E. Voland, *Grundriss der Soziobiologie* (2000), pp. ix, 65.

paradigm. The scientific and popular literature on sociobiology is monumental. Likewise, the issues raised by sociobiology have contributed to create an expanding field of philosophy of biology. Although I have covered much literature in this book, at this point, I confine myself to mention only a few further programmatic writings of the publicly most perceived exponents, Dawkins and Wilson:

> Dawkins' The Selfish Gene (1976) remains the most important biological manifesto of what I am going to call 'gene-Darwinism'. In the The Extended Phenotype (1982), a more academic book, he defends his biological positions slightly more guarded and additionally works out the concept of the extended phenotype. In The Blind Watchmaker (1986), Dawkins has argued in an interesting way that Darwinism is not only actually, but in principle, the only possible theory of evolution. Dawkins wrote several further books on his specific evolutionary theory or the broader implications of his naturalistic view of life: The River Out of Eden (1995), Climbing Mount Improbable (1996), Unweaving the Rainbow (1998), A Devil's Chaplain (2003), The Ancestor's Tale. A Pilgrimage to the Dawn of Evolution (2004), and The God Delusion (2006). I have mainly focused on his three early books which have set forth Dawkins biological position most clearly.
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> E. O. Wilson's main early contribution, besides Sociobiology (1975), was Genes, Mind and Culture (1981), co-published together with the physicist Charles J. Lumsden. There he provides a balanced and detailed mathematical account of the co-evolution of genes and culture. Wilson's most influential book, however, was On Human Nature (1979), where he radically favoured a biologistic understanding of human society and culture. Consilience (1998) is in my view a much more balanced book. Recently, Wilson published, together with B. Hölldobler, a biological work on the sociobiology of insects. The Superorganism: The Beauty, Elegance and Strangeness of Insect Societies (2008).

1.1 Two Basic Postulates

Within the mainstream of early sociobiology two postulates or presuppositions have to be distinguished. They may be considered as the core of the paradigm of sociobiology. One may call these presuppositions basic postulates, though often implicit, since they are basic starting points of argumentation and normally not challenged within the paradigm itself.

a) The Postulate of 'Selfish' Genes as the Only Units of Evolution

The concept of the 'selfish gene' is, in my view, the most central concept of paradigm under discussion. Later I shall formulate the closely related concept of 'gene-Darwinism' and I shall unfold this theory in three aspects: gene-atomism, germ-line reductionism and Darwinian process monism. Here I only provide a first impression of this approach.

When G. C. Williams launched his attack against group selection in 1966[70] and turned especially against the proposals of V. C. Wynne-Edwards,[71] he urged that the burden of proof would rest with group selection and that, in fact, apparent group

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[70] G. C. Williams, *Adaptation and Natural Selection* (1966).

[71] Wynne-Edwards argued that populations appear to regulate their sizes sometimes to levels well below the present environment's carrying capacity. V. C. Wynne-Edwards, *Animal Dispersion in Relation to Social Behaviour* (1962).

adaptations could better be construed in terms adaptations of individuals (or genes). Group altruism, he held, was completely reducible to the fitness of entities at a lower level. The original notion of fitness, applicable to individuals, has been extended by W. D. Hamilton, who introduced inclusive fitness including positive effects on relatives as well. Though Williams argued enthusiastically for explanatory individualism, the concept of inclusive fitness had already left an individualist biology behind, pointing in the direction of a more radical, sub-individualistic, gene-based evolutionary biology. Selection at the genic level appears to explain seemingly cooperative behaviour among closely related organisms, whereas "[o]ther apparent examples of altruism are explained as misplaced parental behaviour."[72] In some respects, a selfish-gene viewpoint indeed seems to have been implicitly present in the texts of Hamilton[73] and R. L. Trivers in particular (but cf. ➲ p. 37 f.). But only Dawkins coined and popularised the metaphorical phrase in his book *The Selfish Gene,* while clarifying and radicalising this position.[74]

In the postulate of selfish genes it is posited that only *single* genes, not cooperative groups of genes, whole genomes, organisms, or species, are the entities which are ultimately selected.[75] Single genes, which appear to be the only persisting replicators, build up phenotypes. The notion of a phenotype has been extended in a consistent and inspiring way, including an organism's behaviour and its products, like a bowerbird's bower or a human's house.[76] In any case, phenotypes (or extended phenotypes) are regarded as mere means of the survival of single genes: they are ephemeral 'survival machines'[77]. Accordingly, *we humans* are regarded to be puppets of our genes, which have only the one 'goal': the replication of our genes.

Dawkins, like Williams, dismissed concepts like group selection and group altruism as clearly mistaken. According to Dawkins, "'altruistic groups' will be over-run by selfish individuals"[78]. Altruistic groups were not evolutionarily stable and hence would not evolve. Like "Chicago gangsters, our genes have survived, in some cases for millions of years, in a highly competitive world. This entitles us to expect certain qualities in our genes. I shall argue that a predominant quality to be expected in a successful gene is ruthless selfishness. This gene selfishness will usually give rise to selfishness in individual behaviour."[79]

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[72] G. C. Williams, *Adaptation and Natural Selection* (1966), Table of Contents, Chapter 7.

[73] But Hamilton had not been an exclusive gene-Darwinian, since he, in certain cases, still acknowledged group selection. Cf.: E. Sober, D. S. Wilson, *Onto Others* (1998), p. 42, ➲ footnote 1035.

[74] R. Dawkins, *The Selfish Gene* (1976/1989). Dawkins generously attributes the founding of this view to W. D. Hamilton. But Dawkins mentions that it was he himself who took this approach to the limit. Dawkins abandoned even Hamilton's notion of inclusive fitness, which, as pointed out by Dawkins, is still related to the ontological level of the individual. R. Dawkins, *Replicator Selection and the Extended Phenotype* (1978)*,* p. 61 f.

[75] R. Dawkins, *The Selfish Gene* (1976/1989), pp. 7, 24f, 33, 39, 40, 55. G. C. Williams, *Adaptation and Natural Selection* (1966), e.g., p. 57.

[76] *Idem*, *The Extended Phenotype* (1982/1989).

[77] *Idem*, *The Selfish Gene* (1976/1989), pp. 48 ff.

[78] R. Dawkins, *The Selfish Gene* (1976/1989)*,* p. 8.

[79] *Ibid,* p. 2.

b) The Postulate of Genic or Biological Determinism

Many proponents of early sociobiology advocated that organisms, and also human beings, were to a great extent (or completely) determined by their competing single genes, since they were the only factors systematically controlling man's biological makeup. Consequently, culture is understood as a biological phenomenon as well.

The reductionism of the selfish-gene account of evolution has reinforced the tendency in science and even more in the tabloid press to use terms like 'gene for homosexuality' in a grossly simplified way. I cannot help but wonder why nobody has yet proposed a gene for Darwinism. Stephen Jay Gould turned against the reductionism of the selfish-gene paradigm and the suggested genetic determinism, instead strengthening the idea of genetic potentiality.[80] After having written *The Selfish Gene,* Dawkins actually conceded that his emphasis on single genes, albeit still the only ultimate units of selection to him, may have caused misinterpretations. He did not intend to deny ontogenetic variability, flexibility and complexity of gene-expressions.[81]

Nonetheless, the selfish-gene account of sociobiology has from early on and widely been interpreted as a claim that humans and other animals are at least in some sense determined by single genes in their general conditions as well as in their special inclinations.[82] I think that at least in several respects such a charge – or description – is justified, because it is essential to Dawkins position, and the later discussed paradigm, to treat organisms as mere vehicles of their genes ('gene machines')[83] and because single, selfish genes are claimed to be the only possible units of selection.[84] In any case, many followers of Dawkins have regarded culture as being a mere part of our extended phenotype, again indirectly at the service of selfish genes.[85]

Correspondingly, sociobiology from early on has been concerned analysing human social behaviour and culture in biological terms. In well pronounced versions, sociobiology was explicated as an "uncompromising application of evolutionary theory to all aspects of human existence"[86]. Cultural phenomena are ultimately seen as epiphenomena, explainable in purely biological terms, with no own causal power of their own. In any case, the have often been taken to be at least indirectly explainable in terms of natural selection and the survival of the fittest. For instance, some sociobiologists have argued that consciousness is a 'real but evolutionarily irrelevant

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[80] E.g., S. J. Gould, *Ever since Darwin* (1973/1991), pp. 251 f.

[81] R. Dawkins, *The Extended Phenotype* (1982/1989), pp. 9-29. Cf. R. Dawkins, *A Devil's Chaplain* (2003/2004), pp. 123-126.

[82] Cf. M. Midgley, *Gene-juggling* (1979); *Selfish Genes and Social Darwinism* (1983), pp. 366 f. S. J. Gould, *Ever since Darwin* (1973/1991), pp. 253 f.

[83] ➲ Germ-line reductionism pp. 311 f.

[84] ➲ Gene-Darwinism in general, pp. 191 f.; on gene atomism in particular, pp. 264 f.

[85] R. Dawkins, *The Extended Phenotype* (1982/1989). Cf. ➲ Sociobiology and ethics, pp. 41 f. Dawkins' concept of memes may provide a remedy against gene determinism. Nonetheless, Dawkins' pervasive reductionism suggests to interprete memes as mere means of genes on a longer leash, ➲ pp. 57 f., footnote 191.

[86] E. O. Wilson, *On Human Nature* (1978/1995), p. x.

property of a system'[87]. E. O. Wilson has advocated that the basis of our emotions, which "are consulted by philosophers who wish to intuit the standards of good and evil", are the hypothalamus and limbic system, which were also formed by natural selection.[88] Wilson concluded that "the time has come for ethics to be removed temporarily from the hands of the philosophers and biologicized."[89] According to such a position, "the humanities and social sciences shrink to specialised branches of biology; history, biography, and fiction are the research protocols of human ethology; and anthropology and sociology together constitute the sociobiology of a single primate species."[90]

This war cry of downward reductionism has not been met by all sociobiologists with the same enthusiasm, but at least in the first decades after the birth of sociobiology, this reductionist spirit has ruled widely perhaps till today. In Chapter 2 possible ethical consequences of such a paradigm will be considered. Later on, new biological developments will be outlined, which may have changed the character of sociobiology as a discipline at least to some extend and which, I think, may well change it in the future.

1.2 The Main Theories of the Evolution of Apparent Altruism – Sociobiological Theorems?

Subsequently, two quite specific theories shall be outlined that are traditionally closely related to the core of sociobiology. These theories are often interpreted as explaining phenotypic 'altruism' in terms of egoism at the genotypic level of the single 'selfish' genes.

> The *evolutionary notion of the 'selfishness'* (Dawkins) or the 'morality' of genes (Wilson) is defined in a 'behaviouristic' sense in terms of outcomes or consequences.[91] M. Midgley has objected that "Genes cannot be selfish or unselfish, any more than atoms can be jealous, elephants abstract or biscuits teleological."[92] I agree that the notion of 'selfishness' in its common vernacular or psychological usage has a conscious and intentional meaning, whereas in evolutionary biology its meaning presupposes a behaviouristic viewpoint and perhaps a consequentialist position. Biologists need to be aware of problems of this specific usage of the term 'altruism'.[93] Nevertheless, this usage of 'selfishness' has its merits and for the purpose of the present investigation I adopt it here.

The theories of kin-selection and of reciprocal altruism had a huge impact on the development of sociobiology as a discipline. Moreover, they are often perceived as the

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[87] H. Mohr, *Freiheit und die biologische Natur des Menschen* (1984), p. 48. Mohr in fact has regretted this result of his analysis. Dawkins appears to hold a similar position. R. Dawkins, *Genes and Determinism* (An Interview by J. Stangroom) (1998).

[88] E. O. Wilson, *Sociobiology* (1975), p. 3.

[89] *Ibid,* p. 562.

[90] *Ibid,* p. 547.

[91] R. Dawkins, *In Defence of Selfish Genes* (1981), pp. 557 f.

[92] M. Midgley, *Gene-juggling* (1979), p. 439; *Selfish Genes and Social Darwinism* (1983), pp. 368-372, ➲ footnote 131.

[93] D. S. Wilson, *Definitions of Altruism and Selfishness* (1992/1998). E. Sober, *What is Evolutionary Altruism?* (1988/1998), pp. 460-462.

two main pillars of the selfish-genes paradigm. The two theories appear to be coherent with the ideas that genes are the only units of selection and that phenotypes are mere survival machines of these genes. However, please note that an interpretation of these theories as only coherent with a selfish-gene paradigm is not uncontroversial.

First, a genic level of selection does not a priori exclude other levels, and the applicability of these two theories of apparent altruism does not exclude that further explanations of altrusistic behaviour do not have their share. This may refute a strict and universal validity of the selfish gene-paradigm even if these two theories have some domain of applicability. Actually many additional biological theories of altruism have flourished in recent years (➲ p. 144 f.).

Secondly, advocates of a pure selfish-gene paradigm need to treat these theories as theorems that are completely reducible to the main postulates of the paradigm. In analogy to mathematical usage, theorems are propositions which deductively follow from basic mathematical axioms or postulates. Additionally, the theorems need not to mean anything above these postulates. Hence, based on the postulates of 'selfish genes are the only existing entities' and 'natural selection is the only existing evolutionary process' (➲ p. 102) one should be able to derive these theorems. Moreover, they should add nothing to these postulates (no new emergent properties). Hence, the theorems should be reducible eliminatively to these postulates. However, this eliminative reduction has been called into question.[94] In my opinion, even these theories constitute a partly autonomous level of explanation (➲ following pages and pp. 138 f., 215 f.). It even may be possible to turn the force of these theories, often taken as supporting the reductionism of the selfish-gene paradigm, against this paradigm itself. Such move may appear peculiar, but it would for instance resemble the use of Mendelian genetics as as a central plank of Darwinism, although Mendelism had been built as bulwark against Darwinism in the first place (➲ cf. pp. 255 f., 399).

In the next two sections I do not dwell on these issues in any great detail, but mainly introduce the theories as if they were theorems exclusively based on the basic postulates of the selfish-gene paradigm.

a) The Theory of Kin Selection

The wording 'kin selection' was coined by the influential English biologist J. Maynard Smith[95], but the formalised concept had been developed earlier by W. D. Hamilton.[96] The appealing, basic idea of the theory of kin selection is that it has an equal survival value for a gene to 'support' an *identical* other gene as to 'support' itself.

By supporting another organism, the information a gene has, does not survive in the gene itself but in the copy present in that organism (➲ p. 255). This 'altruism' can be evolutionarily stable, because the gene which has been helped to survive will still carry the information to 'help' its identical copy.

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[94] See: E. Lloyd, *The Structure and Confirmation of Evolutionary Theory* (1988/1994), pp. 86 f. 120 f. E. Sober, D. S. Wilson, *Onto Others* (1998).

[95] J. Maynard Smith, *Group Selection and Kin Selection* (1964), pp. 1145-1147.

[96] W. D. Hamilton, *The Evolution of Altruistic Behaviour* (1963); *The Genetical Evolution of Social Behaviour* (1964).

Normally this idea is only applied to directly related organisms. The probability of an organism to pass on a particular gene to one's decendant, and hence the probability that this organism shares this gene with this descendant, is normally expressed by the coefficient of biological relatedness, the so-called kin-coefficient r. See Figure 1 for details. Diploid organisms, like humans, have two copies of each chromosome in each (or almost each) cell, one from the mother and one from the father. Hence, for diploid organisms there is generally a probability of 50% for genes that parents pass them on to their direct descendants. There is only a probability of 25% that these genes are found in grandchildren, and so on.

Behaviour which is phenotypically altruistic can, according to this theory, only spread within a population if the following inequality, named after the biologist William D. Hamilton[97], is fulfilled:

$$c_1 < r_{1,2} \times b_2$$

For an 'altruistic' organism (1) the costs (c) have to be lower than the benefit (b) for an organism which receives help (2), multiplied by the probability for the genetic relatedness of the two organisms (r).[98] Dawkins, as advocate of a radical selfish-gene view of evolution, consistently proposed to give up the term 'kin selection' and advocating the reducibility of kin selection to gene selection. "If we accept neo-Darwinian gene-selectionism, kin selection necessarily follows."[99]

> Opposed to Dawkins, for instance, E. O. Wilson discusses the theory of kin selection even under the heading of group selection.➲61 Though largely ignored by gene-Darwinians, also Hamilton himself in his later publications rather tended to a multilevel interpretation of his concept of inclusive fitness.[100]

b) The Theory of Reciprocal 'Altruism'

The second biological theory explains apparent 'altruistic' behaviour as based on the old idea of reciprocity, now applied to evolutionary biology. Robert L. Trivers coined the term 'reciprocal altruism'.[101] The theory posits that behaviour which is phenotypically 'altruistic' can only evolve, if the altruist also profits by it. An 'altruistic' individual or gene will only survive, if it finally supports other individuals or genes 'in order to' support itself.

Axelrod and Hamilton have shown convincingly that, under certain conditions, reciprocal 'altruism' may evolve and will not easily be invaded by organisms or genes with 'cheating' strategies.[102] Reciprocal altruism is hence, under certain mathematical

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[97] W. D. Hamilton, *The Genetical Evolution of Social Behaviour* (1964), pp. 1-16, 17-32.

[98] E.g., E. Voland, P. Winkler, *Aspekte der Hominisation aus Sicht der Soziobiologie* (1990).

[99] R. Dawkins, *Replicator Selection and the Extended Phenotype* (1978), pp. 62, 67, ➲ footnotes 579, 859.

[100] W. D. Hamilton, *Innate Social Aptitudes in Man* (1975). ➲ footnote 1035.

[101] R. L. Trivers, *The Evolution of Reciprocal Altruism* (1971), pp. 35-57.

[102] R. Axelrod, W. D- Hamilton, *The Evolution of Cooperation* (1981), 1390-1391. Cf. R. Axelrod, *The Evolution of Cooperation* (1984). Confer models going beyond reciprocial altruism, e.g., R. L. Riolo, M. D. Cohen, R. Axelrod, *Evolution of Cooperation Without Reciprocity* (2002) (➲ cf. p. 144 f.).

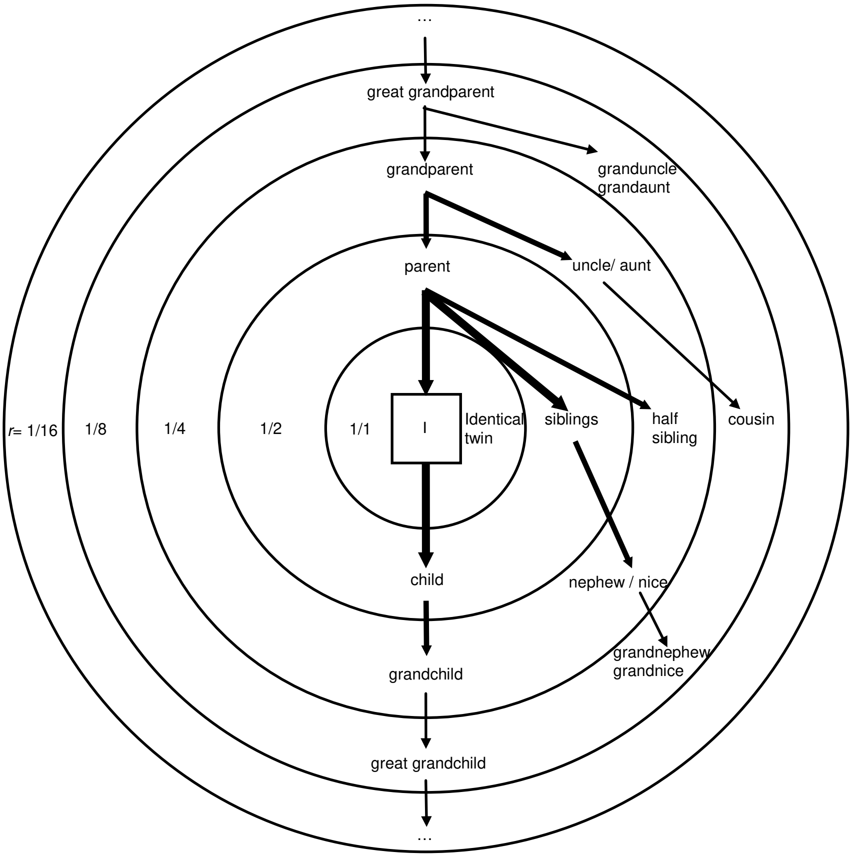

Figure 1: The kin-coefficient *r* plays a central role in the theory of kin selection. *r* is a measure of the relatedness of two organisms. From the 'gene's viewpoint' the *r* values reflects the probability of a gene being present in another organism (actually assuming that the parents of an organism share no genes at all). The figure is valid for diploid organisms (like human beings). The thickness of the arrows indicates the probability for a gene of the focused organism ('*I*') to be transferred in a process of replication by specific relatives (Cf. R. Alexander. *Darwinism and Human Affairs,* 1979).

preconditions, an evolutionarily stable strategy (ESS) – a concept generally introduced by Maynard Smith.[103] This theory has often been used to explain apparent human altruism or some cases of animal altruism that cannot be explained by kin selection (e.g., food sharing in vampire bats). [104]

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[103] J. Maynard Smith, *Evolution and the Theory of Games* (1982). See e.g., the concise overview of A. Rosenberg, *Altruism* (1992/1998), pp. 453-458.

[104] E.g., E. Voland, *Grundriss der Soziobiologie* (2000).

In my opinion, one may well doubt whether the concepts of ESSs and specifically of reciprocal altruism can smoothly be integrated into a radical selfish-gene view, as adherents of the selfish-gene paradigm propose:

> The concept of an ESS may even support the approach of emerging evolutionary mechanisms advocated here. The evolution of an ESS, for instance of reciprocal altruism, needs certain non-reducible preconditions beyond the existence of mere selfish genes. Besides, for example, the ability to 'recognise' co-operators, a minimum proportion of genes need to be in place from the outset so that the strategy of reciprocal altruism may become dominant. These starting conditions may be caused by mechanisms on the population level (➲ pp. 130 f.). Moreover, an ESS could itself be interpreted as a mechanism working on the level of the population. The frequency dependence of an ESS implies that an individual strategy depends on what the majority of the population is doing. But if a population determines the individual gene and not vice versa, it become inappropriate to claim that evolution is only the result of single genes and not the result of properties of gene pools as well (➲ also pp. 246 f., 264 f.). This view is in accordance with J. L. Mackie, who interpreted the concept of an ESS as an irreducible mechanism in its own right.[105] Although Maynard Smith, according to autobiographic notes, has increasingly tended to a reductionist interpretation of his work, he remained open for a more holistic approach and, I speculate, if not pressed to decide between reductionism and holism, Maynard Smith would prefer a middle course.[106] I agree with Mackie that even such a moderate interpretation of EESs, would be critical to Dawkins' strictly gene-Darwinian interpretation.

In any case, proponents of a pure selfish-gene paradigm need to claim that these theories are completely reducible to the idea of single selfish genes. Additionally, all forms of apparent 'altruistic' behaviour need to be explainable by such theorems.

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[105] J. L. Mackie, *Law of the Jungle: Moral Alternatives and Principles of Evolution* (1978), pp. 460-463.

[106] See: J. Maynard Smith, *Shaping Life* (1998), pp. 42-45.

Chapter 2:
Ethical Implications – The Morality of the Gene?

Many – albeit not all – influential sociobiologists have explicitly drawn, or have been inclined to draw ethical, political, and religious conclusions from the view that single selfish genes were the only ultimate basis of biology, culture and ethics. The historical and systematical investigation in the main part aims to unveil the biological and metaphysical inadequacy of the simplistic genetic and cultural reductionism of the outlined paradigm. This preparatory chapter only provides further motives for such an investigation, arguing that the outlined biological paradigm would yield insatisfactory results even if one managed to biologize ethics based on a 'morality of the selfish gene'.

As mentioned, Wilson in his foundational monumental tome *Sociobiology* has claimed prominently that ethics ought to become 'biologicized'.[107] 'The Morality of the Gene', the title of the first chapter of that book, became the credo of a bio-ethical research programme. In the next generation of sociobiologists many followed in his wake, indeed aiming to remove ethics from the hands of the philosophers. Additionally, his followers, coherent with the selfish gene paradigm in sociobiology often skipped Wilson's reference to the possibility of a true 'benevolent' altruism within species and aimed to posit a purified morality of s*elfish* genes.[108]

First, I shall address some basic problems of any biologization of ethics, considering the relation of biology and ethics. Secondly, some actual proposals how moral, ethics or religion may be biologised will be sketched. It appears these proposals often make use of concepts from different philosophical traditions that are not coherent with pure gene-Darwinism. Thirdly, I try to develop a proposal for a more truly gene-Darwinian moral or ethics based on the idea of the selfish gene. Then I shall extend this proposal by taking the concept of *memes* seriously. However, even for this account the outlined reductionistic paradigm seems to lead to results that appear to fall short of most traditional ethics. Assuming that consistency is a general epistemological virtue, one should not only optimise top-down-consistency (here the consistency of ethics with biology), but overall consistency involving bottom-up consistency as well (here the consistency of biology with ethics). There is no a priori reason to think that evidence at some lower level is to be preferred to that at some higher level. The inconsistency between many implications of the idea of a radically biologised ethics and basic ideas of most – traditional and current – ethical systems provides us with another motive for investigating whether it is possible to construct a less reductive biology that may leave a possibility of true altruism and of an autonomy of evolutionary and cultural processes that may go beyond natural selection. After this we embark on a historical and systematic journey in search of an alternative biological and metaphysical view of life.

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[107] E. O. Wilson, *Sociobiology* (1975), p. 562, ➲ footnote 89. E. O. Wilson, *On Human Nature* (1978/1995). M. Ruse, E. O. Wilson, *Moral Philosophy as Applied Science* (1986).

[108] On the comparison of Wilson with gene-Darwinism, ➲ footnotes 58, 59. Cf. p. 191 f.

2.1 Biology and Ethics: Different but Not Unrelated

There is a growing debate on the role of evolutionary arguments in ethics not only in popular science but in philosophy as well.[109] On the one hand, biologizing ethics seems to be an impossible task. At least any philosophy of nature that is not ethical from the outset will not be able to formulate an ethics, which, by definition, goes beyond what is factually given. On the outher hand, evolution seems to provide at least the basis for our actual moral attitudes.

First of all, there is clearly some kind of difference between descriptive and prescriptive claims or propositions. This respectable old idea seems to be part of the *philosophia perennis*. In the last century, G. E. Moore has prominently emphasised the distinction between 'is' and 'ought'. In his *Principia Ethica* he radicalised the objection of his teacher H. Sidgwick against Spencer's naturalistic ethics[110], and firmly opposed any 'naturalistic fallacy' (even Sidgwick's hedonism).[111] Moore argued with logical rigour that the predicate *good* could not be reduced to any other term, like *more evolved*, or *pleasure*. To him being *good* is simple, unanalysable and indefinable.[112] Moore considers any definition of *good* by another notion a *naturalistic fallacy*. Even if one argues that the very logic of moral statements entails that they instruct our actual behaviour (cf. precriptivist positions, like R. M. Hare's), we cannot argue the other way around that our moral and ethical statements were mere summaries of actual behaviour. From a descriptive 'is' premises it is not possible to draw prescriptive 'ought to' conclusions. The traditional separation between descriptive and prescriptive claims reaches back to I. Kant's[113] – and already D. Hume's[114] – distinction of *Praktischer Vernunft* and *Theoretischer Vernunft* (practical and theoretical reason) and might be ultimately traced back to Descartes (➲ pp. 73 f.). Likewise, it is psychologically evident that people distinguish between the use of normative and descriptive rules.[115]

Even in Antiquity, philosophers distinguished *is* and *ought*, but it should be noted that advocates of the philosophical traditions of natural law (like Plato, Aristotle, or Aquinas) saw the 'nature' of man (not meant biologically, but rather teleologically) to be good. Man naturally strives to be good or, in other words, to be close to God. Hence, human nature was conceived to be ethical itself.[116] Alasdair MacIntyre has argued forcefully that only an ontology, which is not devoid of values and teleology,

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[109] G. Kahne. *Evolutionary Debunking Arguments* (2010).

[110] G. E. Moore, *Principia Ethica* (1903/1994), pp. 113 f. Cf. R. J. Richards, *Darwin and the Emergence of Evolutionary Theories of Mind and Behavior* (1987), pp. 322 f.

[111] G. E. Moore, *Principia Ethica* (1903/1994), directly on Spencer sections 29-35, on Sidgwick section 36 f.

[112] *Ibid*, sections 5-14, 23-24.

[113] I. Kant, *Kritik der reinen Vernunft* (1781/1787); *Kritik der praktischen Vernunft* (1788). However, Kant in his Critique of Judgement tried to unify the separated parts of reason. (➲ already p. 78.)

[114] D. Hume, *Treatise of Human Nature* (1739), III. i. 1. (pp. 455 ff.).

[115] E.g., M. von Sydow, *Testing Descriptive or Prescriptive Conditionals and Differential Effects of Frequency Information* (2007).

[116] Cf. J. M. Finnis, *Natural Law* (1995), pp. 606 f.

allowed for proper formulation of ethics.[117] In any case, the hyle-morphistic philosophy influential in ancient Greece posited that a kind of ultimate good (or at least a good that is intrinsic to a particular situation) can be found in the factually given. Nonetheless, the ancients would have agreed with Moore that we cannot simply identify the term 'good' with what we would today call the factually given, since this would render ethics completely affirmative and vacuous.[118]

In philosophy several different approaches to ethics have been developed over the centuries. One may distinguish three main types. A Platonic type of ethics (which in its general outlook may well differ strongly from Plato's own ethical proposals) searches for ultimate and eternal ethical forms or ideas (*eidos*) objectively underlying the factual being. There is a Kantian type of ethics that aims to ground ethics in necessary rational principles, again advocating general necessity, but rather emphasing categorical consequences of following the internal demands of reason than that of an external ethical reality. A third type, which one might perhaps call Aristotelian type, is not concerned with eternal 'ethical forms' found outside of matter, but with forms or laws arising from matter itself. Another related class may be called romantic or historical type. This type aims to discover prescriptive assertations that are normatively valid only relative to a given system or a given time, not eternal ethical laws. So this class can normally be understood as a specification of the Aristotelian type. But note, ethical claims are assumed to be necessarily valid in a particular historical (or evolutionary) context even such an approach will inherit at least some aspects of the Platonic tradition. Hence, reminiscent of neo-Platonism, this approach may be concerned with the emanation or 'revelation' of eternal ethical truth in time. In any case, all these approaches to ethics go beyond the investigation of factual moral beliefs. They aim for consistency and, if they should not only vacuously reiterate that we should behave like we do behave, any ethical system has to transcend what is factually given by definition.

Additionally, independently of whether ethical values are judged to be eternal truth, truth *a priori*, or only necessary in a given context, our *knowledge* about ethics clearly has developed the course of time. In my view, all formulations of ethics, whether they follow Plato, Aristotle, Kant, ulititarianism, or intuitivism are and need to be preliminary. In this respect our understanding of ethics resembles our conception of physics or even mathematics. Even if we aim at finding eternal truth our understanding remains necessarily incomplete. Otherwise, no further investigations would be needed.

It is known beyond reasonable doubt that the human species, in one way or another, has evolved from 'simple origins'. This is the case, even if one may well argue that these simple origins in some sense involved the potency or at least the possibility of all the visible complexity today. Hence there might be some kind of hidden complexity in these simple origins from the outset. Likewise, and perhaps counterintuitively atoms of silicon in some way need to comprise the possibility that semiconductors could be made out of them, otherwise silicon semiconductors would

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[117] A. MacIntyre, *After Virtue* (1981/2007).

[118] G. E. Moore, *Principia Ethica* (1903/1994), section 34.

not be possible (➲ 248 f.). But even if it may well be possible to formulate or uphold a metaphysics emphasising this hidden and successively explored or revealed complexity, 'simple origins' cannot be denied today. But if this is accepted, Moore's defence of the autonomy of ethics against naturalism may paradoxically turn against ethics as such. If one assumed that the account of evolutionary beginnings only involves descriptive propositions and if every change could be reduced to simple evolutionary mechanisms, how should one ever derive prescriptive conclusions? Although Moor's convincing warnings against naturalistic fallacies have to be taken seriously, in my view, 'is' and 'ought' need to be reconstructed in a way that avoids their complete separation. Ethics and ontology may at least be related because they are sometimes unified by a common underlying metaphysics.

The evolutionary and historical record makes clear that the 'ought' – or at least the knowing of the 'ought' – was not always given or obvious, but has at least in some sense come into being (assuming a perspective of mortals). In this sense, the endeavours to build an evolutionary ethics may not necessary deny the ethical perspective from the outset, but they may (partly) be driven by the genuine demand to reconstruct ethics (or moral behaviour) in an obviously evolving world. Correspondingly, some supporters of evolutionary ethics have argued that the boarder between normative and descriptive proposition may not be impermeable. For example, Vollmer has made clear that facts inform us which ethical statements are possible.[119] Obviously, and coherent with modal logics, one cannot ethically demand what is biologically, physically or logically impossible. Moreover, even critics of the sociobiological paradigm concede that philosophers "cannot really complain if somebody tries to fill the vacuum they leave"[120]. Currently, much interdisciplinary research in philosophy, sociobiology, biology and psychology is taking place on the human origin of morals and the intuitive basis of moral thought.[121] Although empirical research on this issue might tend to ignore problems like the naturalistic fallacy, it may help to reveal the essentially ethical character of human nature. That such a moral animal evolved in turn may shed light on evolution.

However, disappointingly the originally demanded biologisation of ethics by sociobiology was often not intended to be a mutually inspiring interdisciplinary research programme. Instead it was often intended to be a hostile takeover of ethics by evolutionary biology. The very ethical question whether moral (or immoral) leanings should be taken as ethical norms (which could have substantial normative implications beyond the tautological claim that 'morals should be like morals are'). Instead biologization has widely been understood as a war cry that a *particular*

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[119] G. Vollmer, *Möglichkeiten und Grenzen einer evolutionären Ethik* (1993), pp. 123-125.

[120] M. Midgley, *Beast and Man* (1978/1995), p. xl.

[121] The literature is diverse and I name only a few examples from different backgrounds: E. Fehr, S. Gächter. *Altruistic punishment in humans* (2002). J. Henrich, R. Boyd; S. Bowles; C. Camerer; E. Fehr; H. Gintis; R. McElreath et al, *"Economic man" in cross-cultural perspective: Behavioral experiments in 15 small-scale societies* (2005); M. D. Hauser, *Moral Minds: How Nature Designed a Universal Sense of Right and Wrong* (2006); Th. Junker, S. Paul. *Der Darwin Code* (2010); M. von Sydow, *Towards a Flexible Bayesian and Deontic Logic of Testing Descriptive and Prescriptive Rules* (2006); F. de Waal, *Primates and Philosophers: How Morality Evolved* (2006).

biological paradigm and its basic principles should be the only basis to understand human culture, including ethics.

The ethical 'implications' of any biological paradigm are difficult to access, since they depend not only on how we define this paradigm, but on our ontological, metaphysical, and ethical framework as well. This framework may differ individually or collectively, and it has been moulded in a long and complicated historical process of learning, reflection and discussion. Nonetheless, the situation may appear radically simpler from the viewpoint of the outlined biological position. Accordingly, one has to give up the universes of old unwarranted ideas and build a system of ethics completely from sketch, based exclusively on the advocated biological basis.

2.2 Philosophical Reactions and Some Accounts of a 'Sociobiological Ethics'

Several sociobiologists and philosophers of biology recoil from drawing ethical or moral conclusions from their biological theory and have resisted Wilson's harsh claim that ethics should become a branch of evolutionary theory. Perhaps, the ethical implications of the pure selfish-gene paradigm may appear too much in contradiction with ethical common sense. For example, would there be any reason to care for the bodily or mentally incapable? Many philosophers regard the claim that ethics is a branch of evolutionary biology as too absurd to merit a considerable response. Even P. Singer, although indeed advocating a biologically informed ethics, has actually dissociated himself from approaches that aim to bridge the "gap between facts and values"[122].

Similarly, Dawkins, a main proponent of the selfish-gene paradigm, states "I am not advocating a morality based on evolution". He has explicitly distanced himself from "elevating meanness and selfishness to the status of ideology".[123] I may well believe that Dawkins personally embraces this position, but it remains highly questionable how far he is justified to argue in this way, based on his own utterly reductionistic view of life (➲ cf. Section 2.4). Dawkins' high-profile polemics against any form of religion – whether true or not – takes his own selfish-gene paradigm as unquestionable explanans to account for phenomena like religion. These phenomena are taken to be only epiphenomenal explananda, bereft of their own explanatory or normative power.[124] In this perspective, however, it becomes questionable why moral behaviour should be exempted from being reducible to the only ultimate ultra-Darwinian explanation: natural selection among selfish genes.

But what does such a biologization of ethics actually imply? The long and controversial history of evolutionary ethics, not necessarily based on the same assumptions about ontology, metaphysics and evolutionary biology, has provided a manifold of different answers to this question (confer, for instance, the work of H. Spencer, J. Huxley, or P. T. de Chardin). Here I only outline some responses to the more recent demand of a 'sociobiologization' of ethics.

Heated disputes concern the biological premisses of the early 'sociobiological

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[122] P. Singer, *The Expanding Circle. Ethics and Sociobiology* (1981), p. 77.

[123] R. Dawkins, *The Selfish Gene* (1976/1989), pp. 2, 267-268.

[124] R. Dawkins, *The God Delusion* (2006).

paradigm' as well as the way ethical conclusions are drawn from this paradigm.[125] At this point I will not get involved with the debates on the biological paradigm, since most of this book is concerned with this issue. I here only mention criticism by some philosophers. While several philosophers ignored the sociobiological paradigm, others met it with a broad range of criticism. This spectrum ranges from approaches favouring completely different philosophies of nature – often linked to 'continental' philosophy – to the detailed analysis of problems of Darwinism or the selfish-gene paradigm – often linked to approaches related to 'analytical' philosophy. Robert Spaemann and Reinhard Löw, for instance, have formulated a neo-Aristotelian, or even neo-Thomistic critique of Darwinian biology, involving a harsh criticism of the early sociobiological paradigm and even of Darwinism in general. They have demanded a rehabilitation of a teleological view of nature.[126] Likewise, Alaistair MacIntyre has argued that a revival of Neo-Aristotelianism may contribute to solve fundamental problems of the 'is-ought' dichotomy inherent to the enlightenment metaphysics.[127] Hans Jonas has advocated that a theory of evolution, if it should lead to acceptable ethical results, must incorporate the concept of freedom from the outset.[128] Michael Weingarten criticised the passive understanding of organisms as mere vehicles and tried to reinterpret organisms as creative, form-giving evolutionary agents.[129] Anthony O'Hear and Thomas Nagel have objected to the reductionism of the selfish-gene paradigm and have bolstered the classical argument that the second nature of man is to overcome his biological first nature.[130]

Closer to the actual biological debates, Mary Midgley, who has always emphasized the evolutionary nature of man, was among the first critics who trenchantly resisted the claim to biologise ethics along the egoistic lines of the selfish-gene paradigm.[131]

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[125] E.g., K. Bayertz (Ed.), *Evolution und Ethik* (1993). W. Lütterfelds (Ed.), *Evolutionäre Ethik zwischen Naturalismus und Idealismus* (1993). A. L. Caplan (Ed.), *The Sociobiology Debate* (1978).

[126] See the excellent PhD-thesis of R. Isak, *Evolutionismus und Teleologie: Eine Auseinandersetzung mit dem teleologischen Denken Robert Spaemanns und Reinhard Löws [...]* (1990/1991). Republished as R. Issak, *Evolution ohne Ziel?* (1992), pp. 53-186.

[127] A. MacIntyre, *After Virtue* (1981/2007). M. McGinn has argued that such an approach may also resolve the mind-body problem, which may be understood as a built-in problem of a Cartesian understanding of matter. M. McGinn, *Real Things and the Mind Body Problem* (1999, unpubl.).

[128] P. Koslowski, Ph. Kreuzer, R. Löw (Ed.), *Evolution und Freiheit* (1984). H. Jonas, *Evolution und Freiheit* (1984); *Organismus und Freiheit: Ansätze zu einer philosophischen Biologie* (1973/1994), e.g., pp. 17 f.

[129] M. Weingarten, *Organismen – Objekte oder Subjekte der Evolution* (1993).

[130] A. O'Hear, *Beyond Evolution: Human Nature and the Limits of Evolutionary Explanation* (1997); *Has the Theory of Evolution any Relevance to Philosophy?* (1987). T. Nagel, *The View from Nowhere* (1986), pp. 78-82.

[131] M. Midgley, *Beast and Man* (1978/1995), pp. xvi-xxii, 89-103, 128-134. In a discussion in the *Journal of Philosophy* Midgley in *Gene-juggling* (1979) formulated one of the most acrimonious critiques of R. Dawkins' *Selfish Gene* (1976). She reacted to an article of J. L. Mackie, *Law of the Jungle* (1978), which she understood to be Dawkinsian (though this may well be controversial). R. Dawkins keenly struck back in his article *In Defence of Selfish Genes* (1981), which in turn was answered by Midgley in the more guarded but still critical article *Selfish Genes and Social Darwinism* (1983). Midgley's book with the title *The Ethical Primate* (1994/1995) is less concerned with a discussion of gene-Darwinism – but she has maintained her objections, pp. 71-91. Midgley's

Since then philosophy of biology has provided many careful and detailed analyses of several aspects of this paradigm.[132] The selfish-gene paradigm sparked (or fired) many debates in the intersection of biology and philosophy, for instance, concerning the units of selection, the nature of altruism, the definition of Darwinism, the meaning of adaptation, the relation of form and function, and the notion of progress. Although some criticism may have been formulated in an ill-considered way, it appears mistaken to me to dismiss all criticism as a reaction of those who were "over-excited by political misunderstanding"[133]. I shall come back to some of these topics later on (e.g., ➲ pp. 144 f.).

We now return to the question, how some main supporters of the early sociobiological paradigm have actually proceeded in formulating a biologized evolutionary ethics. I content myself to briefly outline three influential works, excluding works based on classical ethology or group selectionism, like those by R. Richards or F. de Waal, stressing the plausibility of true altruism within species.[134] However, it will become clear that even the mentioned works are all not exclusively tied to the selfish-gene paradigm. They all make use of an enriched biological basis or of common-sense considerations not fully justified by the advocated biological paradigm.

(1) In his influential book *The Expanding Circle: Ethics and Sociobiology* Peter Singer largely accepted the outlined ontological commitments of early sociobiology.[135] Later he argued (reminiscent of Moore) that facts and values are unbridgeable. Moreover, he claimed that ethical decisions would still have to be based on reason and they could only be additionally informed by sociobiology.[136]

Although I do share Singer's belief in a partial autonomy of reason, I think that this conviction could not be warranted solely on the basis of the outlined paradigm.[137] To the contrary, if the reductionism of this paradigm was taken seriously, it would be more plausible to deny any autonomy of reason. It would be more in line with this kind of evolutionary approach to treat 'reason' as a mere adaptation to an external

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own account has been based on the work of the Nobel laureates K. Lorenz and N. Tinbergen, who have regarded truly altruistic behaviour a usual inner-specific trait (*Beast and Man*, (1978/1995), pp. xv, 19, 23, 138, cf. *The Ethical Primate* (1994/1995), pp. 130-132). She advocated the irreducibility and plurality of motives (pp. 16, 105-115, 134, 142, 152, 168).

[132] E.g.,: D. L. Hull, M. Ruse (Eds.), *The Philosophy of Biology* (1998). C. Allen, M. Bekoff, G. Lauder (Eds.), *Nature's Purposes. Analyses of Function and Design in Biology* (1998). D. S. Bendall (Ed.), *Evolution from Molecules to Men* (1983). U. J. Jensen, R. Harré, (Eds.), *The Philosophy of Evolution* (1981). M. Ruse (Ed.), *What the Philosophy of Biology is* (1989). A. L. Caplan (Ed.), *The Sociobiology Debate* (1978). See also: E. Lloyd, *The Structure and Confirmation of Evolutionary Theory* (1988/1994). E. Sober, D. S. Wilson, *Unto Others* (1998). E. Sober, *What is Evolutionary Altruism* (1988/1998).

[133] R. Dawkins, *Replicator Selection and the Extended Phenotype* (1978), p. 61.

[134] R. J. Richards, *Evolutionary Theories of Mind and Behavior* (1987). F. de Waal. *Primates and Philosophers: How Morality Evolved* (2006). Critically cf. M. Ruse, *Evolutionary Ethics* (1995), pp. 273-280.

[135] But P. Singer mentioned the possibility of group selection. *Expanding Circle* (1981), pp. 18-22.

[136] *Ibid.*, pp. 77, 90 f.

[137] The postulated inner logic of ethics might be consistent with Platonism or an idealist concept of an unfolding of reason, but not with gene-atomism.

environment at the service of egoistic genes, neither committed to an inner consistency nor to the traditional norms of logic or ethics.[138]

> Singer gives an example of the autonomous decision of foster parents to bring up children from a poor economic and social background (pp. 170 f.). A photo of these children may indeed mobilise our tribal instincts. According to the outlined paradigm the emotional inclinations to help people have evolved in groups of very close relatives. At first it may seem possible to build a more universally orientated ethics on such basic tendencies. But foster parents who had become adherents of gene-Darwinism, would, I think, abandon their benevolent views. Understanding themselves now as 'gene machines' they would come to the conclusion that their former impulse to help these poor children does not lead to the maximal reproduction of their own genes. So why should they trust their 'misled feelings'? Thinking of cuckoos in the nest is not motivating to continue the involvement as foster parents.

However we evaluate this example, Singer clearly bases his moral judgments not only on sociobiological premisses but on premisses from other traditions. But if genes built the only relevant ontological stratum, rationality would be part of the organismic vehicle serving nothing but the replication of selfish genes. In this framework any true independence of reason seems impossible. No 'logic of justice' would be able to mould rationality, but it would only be influenced by the selfish interests of competing genes. In difference to Singer, I advocate that the possibility of emergent and independent properties needs to be build already into the core of our ontology (➲ Part IV).

(2) Michael Ruse has reasonably argued that Darwinism, and especially the sketched sociobiological paradigm, has to be taken seriously.[139] Ruse in principle allowed for explanatory levels above genes and he even admitted that the 'overall perspective of sociobiologists' has hidden metaphysical or ideologically commitments towards methodological reductionism. Nonetheless, in several works he adopted a stance in favour of an exclusive focus on genic selection, since this had turned out to be a highly fruitful scientific strategy.[140] To Ruse the advocacy of group selectionist models, on the other hand, was linked to a cultural bias.[141] In some writings, Ruse indeed claimed to be an 'ultra-Darwinian', who takes "adaptation to be the all-pervasive fact" and "natural selection to be the beginning and the end of causation".[142] Ruse advocated that "ethics is an adaptation, put in place by our genes as selected in the struggle for life, to aid each and every one of us individually".[143]

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[138] For similar psychological proposals cf. G. Gigerenzer, K. Hug, *Domain-specific Reasoning* (1992); *Rationality for Mortals* (2008). See also ➲ footnote 887 f.

[139] M. Ruse, *Taking Darwin Seriously* (1986).

[140] Idem, *Sociobiology and Reductionism* (1989), pp. 59-60, 64-65, 78-79; *Mystery of Mysteries: Is Evolution a Social Construction* (1999), pp. 128-129.

[141] M. Ruse, *Mystery of Mysteries: Is Evolution a Social Construction* (1999), Chapter 12, esp. p. 249. Ruse keeps almost silent on the motivation of Dawkins, but he argues that Gould's, Lewontin's and even E.O. Wilson's positions may be due to their cultural background. Chapter 7-9, esp. p. 191. Cf. *Being Mean to Steve* (2000).

[142] M. Ruse, *David Hull Through Two Decades* (1989), pp. 9, 11.

[143] M. Ruse, *Evolutionary Ethics* (1995), p. 257. M. Ruse, E. O. Wilson, *Moral Philosophy as Applied Science* (1986), p. 173.

There is neither an ideal mathematical moral truth nor an "extrasomatic moral truth". Instead "moral premises [...] are the result of an idiosyncratic genetic history". Hence, ethics would be "without justification" and a "collective illusion of our genes".[144]

Although Ruse in these writings seems to be one of the most thorough advocates of applying the outlined biological paradigm to ethics, he sometimes moderated his position. Ruse argued that "biology shows that internal moral premises do exist", they would be feelings about 'right' and 'wrong', which "in fact brought about by ultimately biological processes."[145] Ruse even argued that on this basis a universal moral might be build, which forbids killing and even commands to love your neighbour as yourself.[146] In my view, such strong ethical claims could not be warranted, given that Ruse would truly base ethics solely on the outlined selfish-gene paradigm, exclusively centred around egoistic survival. A thorough 'gene-Darwinian' would have to argue that a benevolent attitude towards groups does today not serve ones gene's survival – as we do not live in groups of close relatives – and hence nothing would speak against dropping this attitude (apart from hypocrisy). In a slightly different context, Ruse actually stated that it will weaken our morality, if we find out that the genes have only deceived us by letting us think hat there is an objective morality.[147] Ruse might have noticed this problem, since in *Evolutionary Ethics* (1995) he seems to have modified his biological position. Although still favouring adaptationism, he seems in some passages to have become a constructivist with remaining Darwinian leanings, stressing not the adaptation of evolutionary lines to an external environment, but an inner dynamics of the communities themselves.[148] I share this view, but I think it is in contradiction to strict gene-Darwinism and even to the core of what is known today as Darwinism (➲ pp. 102, 358 f.). Ruse, who is historically versed, has often described the essence of Darwinism to be '*natural* selection'.[149] Corresponding to this definition, I think that Ruse, even in the mentioned works, has adopted an extended biological basis too.

(3) In *Darwin's Dangerous Idea* Daniel C. Dennett has elaborated a radically Darwinian, and even Dawkinsian, philosophy of nature. Nonetheless, in some passages he warned us that some authors may overemphasise biological determinism.[150] However, Dennett ultimately favoured a Darwinian explanation of our biological and cultural being and he has committed himself to the reductionist selfish-gene approach. He concluded that there is "no denying, at this point, that Darwin's idea is a universal solvent, capable of cutting right to the heart of everything in sight."[151] Consistently,

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[144] M. Ruse, E. O. Wilson, *Moral Philosophy as Applied Science* (1986), p. 173, 186, 187. M. Ruse, *Evolutionary Ethics* (1995), pp. 257, 268, 291.

[145] M. Ruse, E. O. Wilson, *Moral Philosophy as Applied Science* (1986), pp. 174, 179.

[146] M. Ruse, *Evolutionary Ethics* (1995), pp. 257, 287, 264. Rather relativistic statements: pp. 271, 290-291.

[147] M. Ruse, E. O. Wilson, *Moral Philosophy as Applied Science* (1986), p. 179. M. Ruse, *Evolutionary Ethics* (1995), p. 257.

[148] M. Ruse, *Evolutionary Ethics* (1995), pp. 290-291.

[149] M. Ruse, E. O. Wilson, *Moral Philosophy as Applied Science* (1986), pp. 174, 175, 176, 187.

[150] D. Dennett, *Darwin's Dangerous Idea* (1995), pp. 485-493.

[151] D. Dennett, *Darwin's Dangerous Idea* (1995), p. 521.

Dennett has applied this reductive Darwinian approach to different fields, aiming to 'break the spell' of popular delusions of consciousness, morality, or religion.[152] In the chapter *The Evolution of Moral Agency* Dennett has provided an evolutionary explanation of seemingly moral behaviour in terms of gene egoism, stressing that in evolution the welfare of others is never an end in itself [153]. However, similar to Darwin's moderation when writing his *Decent of Men* (➲ p. 112), Dennett appears to be more moderate when concerned with moral agency. He seems to have emphasised phenotypically altruistic behaviour and even conceded that based on some refined models people may demonstrate a firm moral commitment (although they should always profit from it at least indirectly). At some point I have almost been disappointed that I might loose a valuable intellectual opponent (any antithesis may lose its zest, if the original thesis gets less extreme). Indeed Dennett considered long-term orientation of self-interests (despite the myopia of Darwinian evolution), he based central arguments on 'design choice' (although this and 'constraints' have been anathema to ultra-Darwinsm). Finally, he provided an account of the evolutionary stability of a selective kind of altruism (which I would describe as a partly autonomous process, different from natural selection or – more generally – external selection). In my view, such proposals are indeed worth pursuing, but they clearly go beyond the original selfish-gene paradigm.[154] Hence, the closer Dennett had come to address questions of moral judgments, the more distant he got from the reductionist biological paradigm he had embraced at the outset. Dennett's proposal in this chapter does not claim to provide any ethics, but it is obvious that such 'descriptive theories' have effects on moral behaviour. Many will be inclined to combine such proposals with the old ethical postulate that we ought to live according to our *true* nature – an idea influential through the millennia at least since Plato. But if one reintroduced this valuable idea, moral agents (phenotypes) would not be inspired to continue on their path of virtue, since the phenomena are here woven in a narrative concerned with selfishness and reductionism. Acting according ones true nature would mean to act as a prudent egoist and to overcome the vestiges of misled moral intuitions and moral norms like Kant's categorical imperative. Hence, although Dennett's brings this paradigm to its limit, and even beyond, his general advocacy of this paradigm, in my view, contributes to destructing not only naïve common-sense religion, but enlightened ethics as well.

In conclusion, even apparent proponents of a biologization of the humanities appear to use biological or philosophical concepts which go beyond strict gene-Darwinism (➲ pp. 138, 215). Before analysing the historical background of this paradigm and before explicitly challenging this paradigm, I shall try to develop a proposal how a

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[152] *Idem, Breaking the Spell: Religion as a Natural Phenomenon* (2006); *Freedom Evolves* (2006).

[153] *Idem, Freedom Evolves* (2006), Chapter 7.

[154] In my opinion some proposals (like true altruism between altruists, a tendency to overcome blindness, a central role of constraints, or the existence of autonomous processes) are worth considering. However, such proposals should not be formulated as ad hoc claims to explain an anomaly, but require a reformulation of core aspects of the discussed paradigm. See Part III and IV.

biologization of ethics would actually look like if it was truly only based on two central notions of the investigated paradigm, the selfish gene and natural selection.

2.3 The Moral of the Gene? – 'The Currency Used in the Casino of Evolution Is Survival'

How would a biologization of morality or ethics look like that is exclusively based on the outlined biological paradigm? Intuitively one may think of proposals close to common sense: rehabilitation of reproduction as important value, acknowledgment of differences in dominant sexual strategies of the sexes, acknowledgement of the family as a central place of cooperation[155], or an acknowledgment of the continuity between animals and humans. Such, perhaps helpful, proposals may indeed be inspired by some interesting results of sociobiology. But this will not be sufficient if the outlined paradigm informs ethics only with some supplementary facts. Instead the outlined paradigm would have to replace other traditions of ethics, because its formulation does not allow for anything above biology that is not reducible to the natural selection of selfish genes. Given that this provides an exhaustive basis for an evolutionary ontology, what 'ethical' conclusions would have to be drawn? In my view an approach that is truly and exclusively based on selfish-gene Darwinism (and eliminative reductionism) would either have to abandon ethics or at best to reformulate this discipline as the science of prudent egoism.

Bayertz has distinguished in how far approaches in evolutionary ethics claim that the assumed evolutionary theory build an exclusive basis for ethics. In accordance with her results, I think that versions that are based solely on the sociobiological paradigm are not capable of formulating a satisfying ethics. It is questionable how a strong version based only on gene-Darwinism could even provide any prescriptive standards, due to the involved naturalistic fallacy. The weak version, which only claims to explain the evolutionary roots of morality and which does accept a certain freedom as a basis of our moral decisions, seems to be much less inconsistent with common sense or traditional schools of ethics.[156]

Although I sympathise with the weak version of a biologically informed but still autonomous ethics, this approach and the concept of autonomy is in contradiction with a strict interpretation of gene-Darwinism.[157] An extension of the metaphysical basis of gene-Darwinism would be needed to render an 'ethics' with a certain autonomy possible and plausible (➲ p. 54).

Here the goal is to sketch a strong version of 'morality' based solely of the outlined paradigm. Moore's resort of regarding the predicate good as something 'simple, unanalysable and indefinable' is not open to a paradigm, according to which

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[155] Cf. G. Vollmer, *Möglichkeiten und Grenzen einer evolutionären Ethik* (1993), p. 127.

[156] K. Bayertz, *Evolution und Ethik. Größe und Grenzen eines philosophischen Forschungsprogramms* (1993), pp. 24-33. Kitcher has distinguished – and criticised – four ways to biologicize ethics. P. Kitcher, *Vier Arten, die Ethik zu biologisieren* (1993).

[157] Cf. K. Bayertz, *Autonomie und Biologie* (1993), pp. 334, 336, 337, 347. On naturalist theories of evolution in general: H. Krings, *Sokrates überlebt: Zum Verhältnis von Evolution und Geschichte* (1984), p. 174.

everything has to be explained in terms of gene survival. In this view an emergent autonomous property of intrinsic goodness could not exist. The approach also excludes an *inner logic* of rationality, an autonomy of reason or our own emergent (or revealed) purposes which again may influence our behaviour (downward causation).

Hence, only two unpromising ways are open to radical advocates of the outlined paradigm:

The first option is to *abandon ethics*. In this interpretation of evolutionary theory there is only an 'is'; an 'ought to' simply does not exist. This standard interpretation differs from for instance a 'neo-Platonian' interpretation that an 'ought to' may has been hidden, but was present from the outset. Moreover, although the this interpretation of evolutionary theory seems to allow for the evolution of true novelties, the posited reductive evolutionism does not allow for new kinds of entities over and above genes and above natural selection.[158] This paradigm is not burdened by the problems of deriving 'ought to' from 'is', but it hence does not solved any ethical problems.[159] Still one may ask what else would fill the ethical vacuum left by universalised gene-Darwinism. We would have neither reason to combat the process of natural selection – as demanded by T. H. Huxley➲442 – nor to try to channel this process to get more ethical. Truly unselfish altruism or an honest appeal even to abstract moral principles, like justice or equality, would be discredited. Moreover, as in the case of Nietzsche, a non-ethic may, of course, influence actual moral attitudes. Although it is not demanded by this non-ethic, many would actually try to act according to their true nature, and this leads us back to the strong approach, discussed next.

The second option is linked to ideas of *an evolutionary morality*. The other unpromising possibility for gene-Darwinians is to assume – surprisingly a bit similar to the utterly different pre-modern conceptions – that there is no unbridgeable gap between 'is' and 'ought'. According to the outlined paradigm the 'ought to' has to be understood as having evolved only by the mechanism of natural selection; the seemingly independent 'ought to' *is* actually an 'is'. At the first sight, this may be a promising approach. But what does such an idea imply in the context of the outlined highly reductive paradigm of gene-Darwinism?

(1) First, treating 'ought to' as an evolved 'is' may serve as an affirmation of *any* possible ethical system that has actually evolved, paradoxically equally justifying enlightened or religious systems. Taken to its limit one may argue that all moral tenets are justified, simply because we hold them. They have evolved and hence have proved to be evolutionarily (biologically or culturally) stable. Obviously this is close to a tautology: we should do what we anyway belief that we should do – whether it is cannibalism or 'love thy neighbour'. Radical relativism allowing for any possible moral

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[158] R. Dawkins consistently argued against the "unspoken but never justified implication that since science is unable to answer 'why' questions, there must be some other discipline that is qualified to answer them." R. Dawkins, *River out of Eden* (1995), p. 95.

[159] Eve-Marie Engels correctly pointed out that the early advocate of an evolutionary ethics, Herbert Spencer, did not commit the naturalistic fallacy, since he had indeed not been interested in the intrinsic good anyway. E.-M. Engels, *Herbert Spencers Moralwissenschaft – Ethik oder Sozialtechnik* (1993), p. 272.

tenet leads to similar consequences as to assume that there exists no ethics at all: in any case, our ethics would provide no guideline how we should conduct our lives.

(2) One may try to put a deeper tendency or principle of evolution at the core of ones ethics. In classical terminology, one may try to identify the 'essence' either of evolution in general or of a part of evolutionary history, e. g. of human evolution. Julian Huxley thought that progressive integration is the proper characterisation of human evolution. One may argue that an ethical system that is best for a group and will be beneficial for the long-term survival of its members. R. Richards has proposed that men in their normal "structured context" essentially strive "to enhance the community good" and hence "each ought to act altruistically."[160] Such a proposal comes close to a Kantian ethics (by which Richards seems to be influenced) informed by biological facts. However, I think this way is not open to pure gene-Darwinians, who regard the care for the common good of a group to be evolutionary impossible and at best to be an evolutionary side effect.

(3) The most plausible option for gene-Darwinism would be to claim that evolution has had only one essence: selfish genes and an unalterable process of natural selection. If one regards this as the only essence of evolution, one may well be intuitively inclined to draw the conclusion that one should follow the 'selectionist imperative' and multiply by any means.

An orthodox believer in a gene-Darwinian ethics, if purged of all other components, would in my opinion act as a prudent ultra-egoist. The gene-Darwinian would cooperate as long as there is a direct profit. But he or she would whenever possible avoid helping the weak and wounded or previous cooperators that are not of any use any more. The gene-Darwinian would not even try to be a 'fair egoist', as, for example, envisioned by Adam Smith. A radical and consequent follower of such a view would betray, exploit and kill whenever a profit is expected and no punishment or retaliation has to be feared. Morals would be reconceived as nothing but manipulative means of some genes manipulating other genes.[161] There would be no true justice but only different strategies of reproduction. Who wants to blame the cuckoo in the nest, who wants to blame the rapist following his specific strategy of reproduction? Blunt gene-Darwinism indeed has to be taken seriously! Taken to its conclusions this approach may free the rapist from any bad conscience – the only remaining problem for the rapist would be a fear of being caught. If the beautifully austere metaphysical starting point of gene-Darwinism was not extended, the rapist – on this evaluative basis – would be as right as those who would condemn him. A judge, of course, may personally see this differently, but this would not be a question of ethics or justice, but just one of power. The rapist would differ from the judge only in regard of being less powerful to enforce a particular reproductive strategy. On the

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[160] R. J. Richards, *Darwin and the Emergence of Evolutionary Theories of Mind and Behavior* (1987), pp. 613, 620, 622.

[161] E. Voland, *Moral durch Manipulation? Ein evolutionäres Szenario* (1996), pp. 1119-1122. See: R. Dawkins, *The Extended Phenotype* (1982/1989), Chapter 5. R. Dawkins, J. R. Krebs, *Animal signals: information or manipulation?* (1978).

battleground of reproduction, justice would be the first victim, conceived as epiphenomenon reducible to the will of power and egoistic manipulations.

Definitely proposals favouring a sociobiological ethics were made with higher intentions. Some have argued that we have to take the selfish essence of humans into account to solve the most pressing global demographic, ecological and social problems.[162] I do agree that we need to acknowledge the existence of our 'lower' all too human inclinations. It is unproblematic to acknowledge some egoistic tendency (of genes or of individual humans), if some room is left for higher aspirations. For this reason, this radical approach has been highly stimulating, even for debates on morals and ethics. But taken to its limits, this radical approach appears to me to be even dangerous, leading to the denial of all higher values, like justice, truth, happiness and cultural refinement and leaving *nothing but* the selfish genes' bleak tactics in the unrestrainable struggle for life.

It is a problem of pure and unextended gene-Darwinism that it will have the tendency of disavowing any state of justice or truth in a way that is not reducible to single egoistic genes. Without discussing these complex matters in detail, I now mention three pivotal aspects of a strict application of the sociobiological paradigm to morals.

(a) Culture. If culture is also seen as a part of the biological process, ethics would be understood as a specialised branch of biology of a single primate species.➲[90] Despite its complexity and plasticity this biological phenomenon of culture is, according to a strict version of this paradigm an adaptation of single egoistic genes evolved by natural selection. E. O. Wilson writes that our emotions, upon which we base our moral thought, are formed in the limbic system and the hypothalamus and that these brain structures "evolved by natural selection". He concludes that hence our morals evolved by natural selection.[163] Bridging the old gap between the two cultures is done exclusively in a 'bottom-up way'. Ethics gets 'biologicized' from below. What was traditionally the 'higher' realm of freedom is simply explained by the 'lower' processes of biology. According to this approach the resulting morality would not be based on freedom, since the human subject would be regarded as a mere product of the environment and a mere 'vehicle' of genes.[164] A vehicle is not free; it is an object instead of a subject.[165] Even if culture is not understood as being directly controlled by genes, it appears consistent to claim that any renunciation of an advantage in reproduction by emancipation from "the biological imperative to

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[162] E.g., Th. Mohr, *Zwischen genetischer Statik und Dynamik der Lebensbedingungen* (1996), p. 1115. Even M. Ruse and E. O. Wilson in *Moral Philosophy as Applied Science* (1986), p. 192, have been interested in improving the possibility for human long-term survival, though Darwinism itself in principle is only concerned with blind momentary survival.

[163] E. O. Wilson, *Sociobiology* (1975), p. 3; *On Human Nature* (1978), p. 6. Cf. ➲ footnote 147.
P. Kitcher in *Vier Arten, die Ethik zu 'biologisieren'* (1993), pp. 225, 228 f., has pointed out that this argument – against the intentions of Wilson – would also absurdly render mathematics, biology and other sciences to be reducible to natural selection. Kitcher also challenged the assumption that ethics could completely be understood in terms of emotional reaction.

[164] See: G. Vollmer, *Möglichkeiten und Grenzen einer evolutionären Ethik* (1993), pp. 125-126.

[165] E.g., K. Bayertz, *Autonomie und Biologie* (1993), p. 346. M. Weingarten, *Organismen, Objekte oder Subjekte?* (1993).

maximise the genetic fitness", will be immediately punished and eliminated by natural selection of the seemingly 'free' behaviour would again directly be put under a more specific control of the genes.[166] Wilson argued: "Can the cultural evolution of higher ethical values gain a direction and momentum of its own and completely replace genetic evolution? I think not. The genes hold culture on a leash. [...]". He sees culture as the "circuitous technique by which human genetic material has been and will be kept intact. Morality has no other demonstrable ultimate function."[167] Our meaning of life seems to be closely linked to such a biological imperative.[168] Likewise a gene-Darwinian reconstruction of history' consequently sees no other ultimate function. For instance, concentrating wealth "must once have been (or must still be) the means to a reproductive end. No other currency counts in natural selection."[169]

(b) Ruthless selfishness. The paradigm excludes anything above the competition among egoistic genes. It is a main tenet of the sociobiological paradigm that all altruistic phenomena have to be explained by 'egoism' on the level of the genes (➲ pp. 33, 138, 264 f.). Nature is largely conceived to be red in tooth and claw, more than ever before. Even proponents agree that a special unsentimental dog-eat-dog language came to dominate the new paradigm.[170] "Fundamentally, all that we have a right to expect from our theory is a battleground of replicators, jostling, jockeying, fighting for a future in the genetic hereafter."[171] Consistently it has been argued that "so long as DNA is passed on, it does not matter who or what gets hurt in the process. […] Genes don't care about suffering, because they don't care about anything." Generally the "Universe we observe has precisely the properties we should expect if there is, at bottom, no design, no purpose, no evil and no good, nothing but blind, pitiless indifference. [...] DNA neither cares nor knows. DNA just is."[172] Above this phenotypes are mere vehicles, which are only means to promote the ruthless selfish interests of single genes. In a purely gene-Darwinian approach, morality is to be understood as manipulation of phenotypes by some genes to the disadvantage of others.➲161 Saints (anyone pursuing something beyond gene-egoism) would be considered to be either lunatics or sanctimonious hypocrites. This approach would provide an excellent excuse for those not in the least pursuing any higher aims. The actual result for morals based on this paradigm would either be a final erosion of traditional morals or the veneration of competition, without the least constraint. To introduce a higher level is problematic, since this paradigm and hence the resulting morality is committed to the struggle for life, gene against gene, and, as an approximation, individual against individual.[173] Perhaps, this moral seems consistent

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[166] H. Markl, *Natur und Geschichte* (1983, translation by the author), quoted in E. Voland, P. Winkler, *Aspekte der Hominisation aus Sicht der Soziobiologie* (1990), p. 19. The term 'biological imperative' has previously been used by E. O. Wilson, *On Human Nature* (1978/1995), p. 166.

[167] E. O. Wilson, *On Human Nature* (1978/1995), p. 167.

[168] Th. Junker, S. Paul. *Der Darwin Code* (2010), pp. 189 f.

[169] M. Ridley, *The Red Queen* (1993/1995), p. 242.

[170] R. Dawkins, *The Extended Phenotype* (1989/1982), p. 56.

[171] *Idem, The Selfish Gene* (1989), p. 256.

[172] *Idem, River Out of Eden* (1995), pp. 131, 133.

[173] R. Dawkins, *The Selfish Gene* (1976/1989), p. 2.

with the demands of competitive pure capitalism and globalisation, but even any capitalist utopia requires some ideal of justice. Any veneration only of barbaric struggle does not provide us with a moral to create a world that is worth living in.

(c) Survival. In any case this radically reductive paradigm favours only one ‘currency’ – survival. Dawkins has stated explicitly: “The currency used in the casino of evolution is survival, strictly gene survival, but for many purposes individual survival is a reasonable approximation.”[174] Correspondingly, Dawkins has argued that all utility functions of all living bodies reduce to one. “Darwinian theory tells us that all survival is just a means to the end of gene propagation”. “God’s utility function” is maximising the survival of single selfish genes.[175] I think the focus on gene-survival may be the most important aspect of this approach if applied to ethics. E. O. Wilson has conceded it as an unpleasant unavoidable result that “no species, ours included, possesses a purpose beyond the imperatives created by its genetic history.”[176] Hence it is the “biological imperative to maximise the genetic fitness”➲ 166. It could be doubted whether this view, if it dominated common sense morality, would allow for a world-wide sustainable population development. In any case, if getting normative at all, it appears consistent if gene-Darwinism would actually favour only one commandment, one moral principle: “Thou shalt survive in the struggle for life.” Or put more precisely: “Thou shalt strive to maximise the replication of thy genes with all thy means and thou shalt not ever have any scruples towards thy neighbours in achieving this purpose.” This principle, whether explicitly postulated by the experts of ethics or not, would tend to replace traditional religious and philosophical values, like love, piety, goodness, benevolence, *eudaimonia*, happiness, courage, justice, duty, respect, beauty and truthfulness. Such an understanding of morals or ethics would not only be in fundamental contradiction with almost all religious beliefs but as well with all traditional philosophical schools of ethics, from Platonism and Aristotelianism, over Kantianism[177] to Hedonism and Utilitarianism. In particular this view would be in stark contrast to any form of ethics based on freedom or on rational consideration of what is good. “In a universe of blind physical forces and genetic replication, some people are going to get hurt, other people are going to get lucky, and you won’t find any rhyme or reason in it, nor any justice [...]”[178] Likewise, a consequentialist act-utilitarian ethics which procures the greatest happiness for the greatest numbers of people seems to be at odds with such an approach. Why should one care for happiness? Why should one care for others at all? The only ‘normative’ purpose of evolution would be the unchangeable tendency to survive, a tendency of genes acting as maximally selfish as possible. Even if promoters of an ‘ethics’, which is purely based on the selfish-gene paradigm, might by far surpass my imagination in their ability to develop a more complex and satisfying moral system, how would such an ‘ethics’ focusing only on biology, competition and survival, if popularised, affect our lives?

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[174] *Ibid,* p. 55.

[175] R. Dawkins, *River Out of Eden* (1995), pp. 104-106, 124.

[176] E. O. Wilson, *On Human Nature* (1978/1995), p. 2.

[177] In the light of Kant’s own writings, a biologistic interpretation of his *a priori* is inappropriate.

[178] R. Dawkins, *River Out of Eden* (1995), p. 133.

2.4 Meme 'Altruisms'? – A Further Extension of the Sociobiological Paradigm

a) Memes – A Limited Comeback of the Idea of Logos

After the concept of memes will be introduced, I shall propose two additional memetic mechanisms, in order to then access the ethical implications of this extended approach.

As outlined, conventional sociobiology tries to reduce apparent biological forms of 'altruism' to the concept of genetic 'egoism', dismissing altruism of groups or species.

Dawkins in *The Selfish Gene* has briefly introduced another basic concept, that of so called *memes*.[179] Memes – analogous to genes – are replicators on the cultural level, "the smallest elements that replicate themselves with reliability and fecundity." They are claimed to be bits of knowledge, of human practices or, in my view, they could be objectified in an object. They jump from brain to brain or can be photocopied. Memes are defined as standing in competition and as evolving solely by natural selection.[180]

Although the concept of a meme ('the meme of a meme') seems not to be very common in sociobiology, it has itself clearly become a prolific replicator in the texts of philosophers, like D. Hull[181], or D. Dennett[182], and psychologists, like H. Plotkin.[183]

There is an often ignored history of similar ideas. One aspect of the concept of *memes* is that it (seemingly) refers to an independent higher level of information above biology. The many aspects of the concept of a meme have a much longer history than its new name, reaching back at least two and a half thousand years to the concept of *nous* (partly also to the concept of *logos*), presumably best translated as *spirit,* or in an individualistic sense as *mind.* Note the same etymology of *mind* and *meme*. Germanic *muni* had meant spirit as well (I am perhaps aware of it, since my own forename, '*Momme*' is derived from this word) and is related to Greek *mimneskein* and French *même*. *Nous* often referred to the largely independent process of culture, with emphasis on the history of ideas.

> In Christian philosophy, spirit (lat.: *spiritus*) spirit proper (*spiritus rectus*) was individually and supra-individually directed towards God. In Greek philosophy *nous* and *logos* were often conceived as a process of teleological rational unfolding. Though *nous* also was understood in the sense of static Platonic ideas, which could be grasped by individuals, neo-Platonic influences (as in the reception of Aristotle) seem to have contributed to a more dynamic and collective interpretation.
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> To Hegelians – here resembling neo-Platonists – philosophy as a whole is centred around the notion of spirit (*Geist*). *Geist* to Hegel is processual, already in nature but mainly in history. Hegel distinguishes between the subjective spirit, focusing on individual reflective processes, the objective spirit, focusing on the supra-individual historical reflective

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[179] R. Dawkins, *The Selfish Gene* (1976/1989), Chapter 11, pp. 189-201; *The Extended Phenotype* (1982/1989), pp. 110-112.

[180] D. Dennett, *Darwin's Dangerous Idea* (1995), pp. 344-345.

[181] E.g., D. Hull, *The Metaphysics of Evolution* (1989), p. 7.

[182] D. Dennett, *Darwin's Dangerous Idea* (1995), pp. 341-370.

[183] H. Plotkin, *Darwin Machines and the Nature of Knowledge* (1994), pp. 215-227 (esp. p. 218).

processes, and finally the absolute spirit, reflecting freely the highest values and the process of reflection itself.

At the turn of the 20th century Dilthey tried to re-establish the concept of a cultural objective spirit (*objektiver Geist*). Ideas can be objectified for example also in architecture. In the following philosophical movement the *Geist* was concerned not with individual psychology but intellectual and cultural history. Correspondingly, becoming a true person was understood as adopting culture, as the cultivation of mind. The biologism at the time of the Nazis did deemphasis any independence of the spirit (culture). Today, one of course needs not to be a Hegelian in order to argue that there is a partly autonomous history of ideas.

Types of 'Altruism' Based on Memetic 'Egoism'	
Meme-'Altruism' based on Relatedness or Similarity	Corresponding to kin selection on the biological level, memes might 'egoistically' support their 'relatives' in the same 'brain' or in different 'brains', if they were identical (or similar enough). One might formulate a mathematical inequality analogous to Hamilton's (➲ p. 38), in which memes would replace genes. One might even go one step further. In principle one may think of *Meme-Similarity Altruism,* where similarity replaces relatedness. But this transcends the Darwinian stress on a branching descent without synthesis. Nonetheless, information would support a copy of itself outside of itself. In academia, for example, the support of adherents of the same school may – apart from more idealistically considerations – be based on such a process.
Reciprocal Meme-'Altruism'	Corresponding to genetic reciprocal altruism, this theory would predict reciprocal 'egoistic' support of memes. Analogous to the biological case this could only evolve in a meme pool where reciprocal altruism of some sort becomes an evolutionarily stable strategy and is not overrun by concepts which do not reciprocate the support.

Table 1. Basic Types of Meme Altrusism

Though Dawkins' concept of a meme seems to revive the venerable concept of *nous* or spirit in claiming a process of cultural transmission of immaterial information[184], it strongly differs from it in several respects.

First, the original notion of *nous* is narrowed down by the notion of memes, abandoning its rational, normative and teleological connotations.

Secondly, memes are normally conceived in an atomistic way as totally separate, stable and independent entities.

Thirdly, memes are taken to be 'selfish' by only 'aiming at' their self-reproduction. They are claimed to evolve in a Darwinian way by blind variation and external selection, resulting in a tree of conceptual decent.[185]

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[184] Note how the term in*formation* resemblances the Greek term *eidos,* form ➲ pp. 251 f., 311 f.

[185] ➲ pp. 57 f.

These novel aspects, especially the second and third point, have been criticised.[186] For example, how could one in such a Darwinian framework account for the crucial role of intellectual synthesis in the history of ideas?

However, such a memetic extension of the selfish-gene paradigm, leads us from simple gene-Darwinism to a simple kind of (universal) process-Darwinism.[187] Crucial question in the context of ethics are: Does the concept of memes reintroduce an independence of culture, on which the selfish-gene paradigm actually had declared war? Does this concept allow to reintroduce the concept of an independence of the cultural level from the biological level? If this was the case, one would transcend, and I think improve, the biologistic gene-Darwinian research programme. Some kind of ontological dualism would be revived in a monistic framework and Descartes entered through the back door. Before discussing this proposal, I want to go one step further by adding two types of apparent 'altruism' based on memetic 'egoism' (cf. Table 1). Although I have not found this proposal elsewhere, it follows obviously by analogy from the biological theories of kin selection and reciprocal altruism.

Comparatively to gene-Darwinism a memetic account seems to provide a positive extension, including a modified reintroduction of the concept of nous. Although memetic kin selection and memetic reciprocal 'altruism' seem to relate to the viewpoint of 'selfish memes', I would suggest – as I have done for the biological stratum – that it actually requires further irreducible conditions to effect these processes (starting conditions, recognition of kinship, etc.).

In the next section it will become apparent that the ethical results remain problematic in any case.

b) Problems of the Extended Genetic-Memetic Approach as a Basis for Ethics

Although we seemingly have left gene monism behind us, I am going to argue now that the meme concept is not reconcilable with strict gene-Darwinism, even if restricted to the biological sphere. In any case, this approach – without further modifications – would still deteriorate common morals to a tactic to best ensure the survival of one's genes and memes.

(1) *Biological determinism.* The meme concept initially seems to overcome biological determinism. Even Dawkins indicates in *The Selfish Gene* that he regards an independence of the memetic level to be possible.[188] I would appreciate a certain independence of *nous* from its biological basis and the meme approach may contribute to such an account. Nevertheless, in two regards an interpretation as independent appears to be inconsistent with gene-Darwinism.

(a) Gene-Darwinism is essentially an enterprise of thorough downward reduction. I will later discuss gene-atomism, germ-line reductionism and process reductionism as different aspects of this downward-reductionist attitude. Within this generally reduc-

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[186] E.g., D. Holdcroft, H. Lewis, *Memes, Minds and Evolution* (2000).

[187] ➲ The historical parallels of Darwinism with other subject areas (pp. 154 f.), universal process Darwinism (pp. 209 f.), and the critique of process reductionism (pp. 333 f.).

[188] R. Dawkins, *The Selfish Gene* (1976/1989), pp. 191-193, 201, 331; *The Extended Phenotype* (1982/1989), pp. 110-112.

tive paradigm an autonomy of higher levels seems implausible.[189] Within an individual, selfish genes would be regarded to be more basic than memes (though I think this is not necessarily so). In this framework memes are plausibly understood to replicate only at mercy of genes. This would imply that humans would still normally only propagate ideas that directly serve the survival of the propagator's genes. Since the idea of an inner logic of rationality (one decedent of the old concept *logos*) is alien to a selectionist account, memes, like any other adaptive organs, would at the outset be understood as being only vehicles for genes in their struggle for life. Consistently human communication has been proposed to be mainly at the service of the genes, coresponding to Dawkins' and Krebs' understanding of "all of animal communication as manipulation of signal-receiver by signal-sender"[190]. At this point it seems that one is forced to join the advocates of orthodox gene-Darwinism, who reproach Dawkins for being inconsistent and a turncoat considering the autonomy of memes.[191]

> Nevertheless, if we neglected the downward reductionist framework, I think, it is possible to argue that even the simple process of natural selection could in principle 'bring life' into the ontological level of concepts. However, there is no reason to assume that life has been restricted to this simple process. But within the gene-Darwinism framework, I consider this meme concept as not being stable yet.

(b) The autonomous conception of memes appears to unstable also because a certain cultural autonomy would undermine the radical gene-Darwinian polemics in human biology and culture. Moreover, if downward reductionism would be weakened by introducing another level, it may become more questionable within biology as well.

In addition, human phylogenesis would have to be conceived differently as it is by the standard reductionist account. The polemics that our emotional and our limbic system evolved by 'natural selection' would then be an unwarranted simplification. Our emotional system indeed may partly have evolved by 'cultural selection' or even 'moral selection', partly via sexual selection (generally by autoselection) rather than by natural selection (hetero-selection). But allowing for cultural influences on gene survival, our genes may not necessarily be as selfish as they might be. The resulting view would be quite different from the popularised selfish gene approach.[192]

In summary, it will be at least difficult to sustain the independence of memes on gene-Darwinian grounds. However, if this were possible, this might undermine gene-Darwinism. This line of argument, like several others in this book, may suggest a tendency of gene-Darwinism to transcend itself.

> Moreover, one of the main epistemological motivations to develop evolutionary naturalism has been the hope of resolving the modern epistemological problem of truth and reference, dominating philosophy since Descartes, by an objective theory of correspondence. But as far as an independence of the meme-level would be conceded, evolutionary epistemology would

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[189] E.g., K. Bayertz, *Autonomie und Biologie* (1993), p. 336.

[190] *Ibid,* p. 57.

[191] R. Dawkins, *The Extended Phenotype* (1982/1989), p. 110.

[192] E. O. Wilson, *On Human Nature* (1978/1995). Wilson together with C. J. Lumsden in a profound work, *Genes, Mind, and Culture* (1981), have provided a differentiated account of the co-evolution of genes and memes.

> need to become a truly evolutionary and historical epistemology. Hence, the traditional epistemological problem would arise again. One would again lose the correspondence of the appearances to the things in themselves, which one hoped to gain by the concept of adaptation. Accordingly, the discourse on evolutionary epistemology has started to reduplicate a whole range of traditional epistemological positions, from realism to non-realism.[193]

(2) *Competition.* Even if some autonomy of memes would be consistent with the outlined paradigm, competition among atomic entities would remain the only driving force of biological and cultural evolution. Certainly, an extended meme approach leaves more room for cooperation on the level of individuals. Nevertheless, cooperation would still not be based on the notion of the common good, but would be pursued only to reproduce ones own genes and memes regardless of their content. It will be shown that the radicalness of this emphasis can be challenged even within the biotic stratum and, of course, even more in the cultural stratum.[194]

Moreover, the notion of intrinsic goodness is completely missing. Each entity simply strives for its own survival. The Thou (e. g. in the sense of Buber) or the Other (e.g. in the sense of Levinas) have no intrinsic value in this conception at all (➲ pp. 418 f.), as far as they do not benefit the survival or the reproduction of the entity in question. Based on the 'principle of egoism' living entities are defined by a caring for themselves, altruism by definition is explained by egoism.

Additionally, all aspects of atomistic and Darwinian meme conception may be questioned and will be questioned in this work. It is questionable whether there are atoms of thought that do not change in their contexts. There seems to be interrelated conceptual levels, from single notions over theories to world views, each may perhaps be influenced by its context. It is questionable whether a replicator-vehicle dichotomy is really applicable to ideas. It is questionable whether these concepts evolve only in a Darwinian way of blind variation and external selection, without a crucial role of synthesis. Although the meme concept has positive sides, I prefer to speak of *logoi. Logoi* is the Greek diminutive of the old philosophical notion of *logos,* referring to the development of ideas with a certain life of their own. However, in contrast to memes, logoi are not interpreted in a purely atomistic and Darwinian way.

(3) *Blindness.* As outlined, the only measure which exists for Darwinism, for genes and memes alike, is short term survival (➲ pp. 358). The notion of sustainability appears to be opposed to any Darwinian concept of evolution. Darwinian biological and cultural evolution, by definition, cares in an unchangeable way only for the

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[193] On evolutionary epistemology and Universal Darwinian Processism, ➲ pp. 205 f. D. T. Campbell and K. Lorenz introduced the notion of *hypothetical realism,* which has found several followers: K. Lorenz, *Die Rückseite des Spiegels* (1973), pp. 17-20, 303. G. Vollmer, *Evolutionäre Erkenntnistheorie* (1975), pp. 34-40; *Was können wir wissen?* (1988), pp. 285-290. R. G. Meyers, *Evolution as a ground for realism* (1990). R. Millikan, *Language, White Queen Psychology and Other Essays for Alice* (1993) [Quoted in B. Pollard, *The Nature of Rule-Following* (1996)]. Recently non-realist positions have been formulated. E.g., D. Campbell, *Epistemological Roles for Selection Theory* (1990). M. Ruse, *Does Evolutionary Epistemology Imply Realism?* (1990).

[194] The critique of gene-atomism ➲ pp. 264 f.; on the melting of ideas, ➲ e.g., p. 364. Also process reductionism and a missing concept of goodness are linked to this approach ➲ pp. 57; 333.

moment (➲ pp. 396 f.). The concept of an invariant blindness of the process will be challenged in this work (➲ pp. 371 f.).

Despite the improvements of the extended gene-meme theory (of which I will make use in my own ontological proposal), I think it is not possible yet to build up a satisfying ethical system on these still atomistic and Darwinian grounds. The meme concept may be helpful to overcome biologism, but in this case, I think, it becomes inconsistent with biological gene-Darwinism.

2.5 The Need for a New Paradigm in Biology

It has been shown that the ethical and moral consequences of a pure gene-Darwinian philosophy appear untenable and at odds as well with common sense as with many well established ethical systems. Of course it may turn out that the common good of our society, our established ethical principles, and the concept of free individuals may all be illusory – at best they would be some epiphenomenal or ephemeral phenomena, “like clouds in the sky or dust-storms in the desert.”[195] A consistent unification of different subject areas, as demanded by E. O. Wilson, is a formidable claim: “It may not be too much to say that sociology and the other social sciences, as well as the humanities, are the last branches of biology waiting to be included in the Modern Synthesis.”[196] Such an unification would have its merits, but if a theory makes such strong claims we do have to scrutinise it as critically as possible.

In science a bottom-up explanation based on postulated elements may predict a behaviour on the compound level. But if the phenomena on the compound level are not well explained, one may not only question the validity of the phenomena on the compound level but also the theory at the elementary level. Bottom-up consistency is a virtue, but top-down consistency is a virtue as well. Correspondingly, I think the situation obviously demands to search for a different biological foundation that may be more in line with our basic ethical beliefs. Since biology and ethics have not been treated as isolated fields one cannot regard this as an exogenous argument. If one accepts the epistemic value of overall consistency and sees the ethical challenges of this paradigm, the search for another paradigm seems to be the only responsible and reasonable strategy.

When we are going to scrutinize the biological and philosophical debate, it will turn out that evolutionary biology is far from being monolithic. The selfish-gene paradigm has to face several anomalies. This will provide us with additional reasons for the goal to formulate a refined interpretation of what one may call ‘facts’ of evolutionary biology. However, I shall mainly try to transcend gene-Darwinism from within (➲ pp. 243 f.).

Dawkins wrote that “philosophy and the subjects known as ‘humanities’ are still taught almost as if Darwin had never lived. No doubt this will change in time.”[197] I

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[195] ➲ footnote 1053.

[196] E. O. Wilson, *Sociobiology* (1975), p. 4.

[197] R. Dawkins, *The Selfish Gene* (1976/1989), p. 1.

agree with this criticism to some extent, but I would add conversely: “Biology and especially sociobiology is still taught almost as if these disciplines would not have any historical roots and would not have made any philosophical presumptions. No doubt this will change in time.” For discussing possible problems of a biologistic selfish-gene paradigm we first aim to understand its history and its underlying philosophical structure.

Part II: The Unfolding of Logos in Regard to the Conceptions of 'Physis' and Darwinism

"Each succeeding age discovers that the primary classifications of its predecessors will not work. In this way a doubt is thrown upon all formulations of laws of Nature which assume these classifications as firm starting points. A problem arises. Philosophy is the search for its solution."

A. N. Whitehead, 1934.

In our search for a new biological paradigm, I am going to discuss the historical construction[198] of the selfish-gene paradigm and of Darwinism in general. In this part the used approach to the history of science seeks to provide a deeper historical-genetic understanding of the discussed theories and at least to point out constructional alternatives.

Within the historiography of science – and therefore also within the historiography of biology – some types of approaches are often distinguished.[199]

(1) *Internalism*, which is often held by scientists working as historians in their own field, is the view that science or a particular scientific theory is completely distinct from any external social or intellectual influence. Hence internalists focus on developments *within* a particular science. For instance, the zoologist Ernst Mayr, one of the founders of the so-called evolutionary synthesis, has been one of the most profound internalist historians of biology.[200] Philosophical positivism will usually favour an internalist position, but internalist accounts may be reasonable even from other perspectives.

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[198] Cf. P. Bowler, *Charles Darwin* (1990), Chapter 'The Problem of Interpretation'; *Evolution* (1984), pp. 341-342.

[199] Similar: E. Mayr, *One Long Argument* (1991), p. 39; *The Growth of Biological Thought* (1982), p. 13.

[200] E. Mayr's main work is *The Growth of Biological Thought* (1982). A popularised but informative short version is: E. Mayr, *One Long Argument* (1991).

(2) *Externalism* emphasises that science and any scientific theory is embedded in and determined by its more general intellectual and cultural context. This position is primarily held by historians, sociologists and philosophers working in history of science. Within externalism one has to distinguish two approaches: one group of the historians rather focuses on the socio-economic, the other rather on the intellectual context of a theory. In practice of course, most externalist historians could be placed somewhere between these extreme positions.

(a) Some externalist historians of science emphasise the *socio-economic* context. They often have a sociological background. These accounts of the history of science justly take sociology and economics seriously. Some socio-economic accounts implicitly or explicitly reduce the role of ideas and belief systems to nothing but mere epiphenomenal superstructure built on a given socio-economic basis, like individual economic interests or class interests. This may, for instance, philosophically be linked to a postmodern approach, a Marxist approach, or even a radical neoliberal approach. Analyses based on this methodology have led to revealing insights, but in my view a complete reduction of ideas to interests clearly goes too far, because it ignores the inherent compellingness of evidence and arguments themselves. Other advocates of the socioeconomic approach have convincingly tried to reconstruct in detail the whole *Lebenswelt* of a scientist in question (for example, A. Desmond and J. R. Moore in their brilliant biography of Charles Darwin[201]).

(b) On the other hand there are historians of ideas (e.g., J. C. Greene[202]), who focus mainly on the *intellectual* context of certain concepts. This is based on the two assumptions that knowledge is not a mere *epiphenomenon*, and that the different parts of knowledge or human *logos* interact with one another. The tradition of world-views, into which a scientist is 'thrown', determines or at least influences the way he or she builds up theories and experiments and thus perceives the World. Theories are regarded as both affecting and being effected by the temper of an age. Within this framework historians again have very different approaches. They may be for example implicit or explicit followers of Fichte, Schelling or Hegel, and will focus on the unifying logic within the whole logos or what these philosophers called 'Spirit'. Or they might e. g. be influenced by very different 'postmodern' philosophers, like Derrida and Foucault, who similarly focus on 'discourses' shaped by a general 'episteme' of a time.

The internal-external distinction in historiography is a relative one. A treatment could be internal or external in regard either to a specific theory or to a whole scientific discipline in question. Moreover, it is difficult to subsume historians of science under the outlined categories. This holds even for the mentioned historians, and is even

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[201] A. Desmond, J. Moore, *Darwin* (1991/1992), pp. xvi-xviii.

[202] John C. Greene tries in *Science, Ideology, and World View* (1981) to show the impact of ideology and World Views on the Darwinian Revolution. In the essay *The Kuhnian Paradigm and the Darwinian Revolution in Natural Selection* (first publ. 1971) he outlined his methodology in contrast to the one of Th. S. Kuhn.

more difficult for instance for S. Kuhn[203], P. J. Bowler[204], or D. J. Depew, and B. Weber[205]. Indeed it seems to be fruitful to regard the mentioned approaches to history of science not as exclusive, but as complementary. In my view, especially in phases of scientific revolution, both internal and external reasons for the process of scientific construction have to be taken into account. It would be false to exclude history of ideas or socio-economic history from historiography. History in general and the history of a certain science or even of a theory will sometimes be interwoven with each other. History, according to this position, can only be understood by looking at the partly autonomous subhistories; and the partly autonomous subhistories are only understandable by relating them to history as a whole.[206]

> This historiographic position mirrors my *general epistemological assumptions*. In historiography there is no strictly isolated theory, no completely unrelated 'Sprachspiel', no discourse totally on its own, no isolated logoi; but neither is there a completely homogeneous temper of an age, a completely consistent *Zeitgeist*, *logos* or 'episteme'. We are concerned with a historiographic whole-part problem and, in my view, only a middle position can reasonably be advocated.
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> In regard to epistemological or ontological part-whole problems I shall later develop a middle position in more detail. The *epistemological part-whole problem* could be exemplified by Wittgenstein's ambiguous picture of a duck-rabbit[207]. This simple picture shows, I think, that both extreme positions are one-sided – at least if we are concerned with our actual cognition: a) If there were only bottom-up perception, then we would not be able to switch voluntarily between the perception of a duck or a rabbit. b) Our perceptions could neither, the other way round, be exclusively rely on top-down assumptions, here on abstract concepts of a duck or a rabbit. (Otherwise one could equally make us belief that there is an elephant.) I. Kant favoured a balanced solution: "Gedanken ohne Inhalt sind leer, Anschauungen ohne Begriffe sind blind."[208] Also in my ontological approach wholes and parts are interacting.[209]

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[203] Thomas S. Kuhn's influential book *The Structure of Scientific Revolutions* (1962) is in large parts concerned inner-scientific explanations and a specific scientific community, which are part of the science in question and in this sense internal. His theory, however, left the explanatory gap why paradigm shifts occur, and hence may even mark a trend of historiography towards externalist approaches, trying to close this gap. Moreover, Kuhn called attention to factors, like the scientific community, which are at least external to the theory in question.

[204] P. Bowler, *Evolution* (1984/2009); *The Non-Darwinian Revolution* (1988); *Charles Darwin* (1990); *Life's Splendid Drama* (1996).

[205] D. J. Depew, B. Weber, *Darwinism Evolving* (1995).

[206] The romantic view of history has been described along similar lines: 'The development of the natural sciences is genetic, possesses an internal logic and depends on economic and social factors. Internal and external dimensions do not have to be mutually exclusive.' D. v. Engelhardt, *Historical consciousness in the German Romantic Naturforschung* (1990).

[207] L. Wittgenstein, *Philosophische Untersuchungen* (1953/1958/1976), p. 194.

[208] I. Kant, *Kritik der reinen Vernunft* (1781/1787), p. A 51/B 75. ("Thoughts without content are empty, intuitions without concepts are blind.")

[209] ➲ Part IV, Chapter 8. I oppose substance (pp. 245 f.) and process reductionism (pp. 333 f.) and advocate a more holistic position, top-down causation (pp. 272 f.) and exformation (pp. 316 f.). However, I intend to pursue a middle course between atomism and holism.

Consequently, both approaches to the history of biology, the internalist and the externalist approach, will be pursued. Nonetheless, I use two separated chapters to develop each of them, so that each gets the deserved attention. In Chapter 4, '*From Darwin to Dawkins*', the *internal* logic of different Darwinian subparadigms will be explored. I shall support the hypothesis that there have been certain distinct, but minor, paradigm-shifts *within* the main theory of Darwinism, and I shall thus challenge the assumption often found in popular science that perceived Darwinism is a monolithic theory. I will try to show how, with these subparadigms, central notions (like 'gene', 'unit of selection', 'species' etc.) underwent a change of meaning.

In Chapter 5, on '*Darwinism – from Whig Biology to Neoliberal Biology?*', a survey of the external influences *on* Darwinism and of the Darwinian influences on other external theories will be given. I try to show that Darwinism and Dawkinsism are not only reactions to empirical 'facts', but partly influenced by general theories and philosophical beliefs. For example, it is broadly acknowledged that Darwin was influenced by Malthus and the classical liberal economic theories. Without denying the importance of a moderately socio-economic account, this chapter focuses on the *intellectual* external history.

Based on the historical interrelations of Darwinism with other academic disciplines, I shall develop in the following Chapters 6 and 7 systematically what I call 'Universal Darwinism' and especially 'Process-Darwinism'.

Before we consider the internal and external history of different Darwinian subparadigms, Chapter 3 on the '*Unfolding of the pre-Darwinian Philosophical Conceptions of 'Nature'*' provides a sketch of the philosophical traditions on which modern biology is built – or from which it has distanced itself. In this first chapter of the historical part internal and external history are not separable, because biology still is, quite directly, part of the general intellectual and philosophical development.

Chapter 3: The Unfolding of the Pre-Darwinian Philosphical Conceptions of Nature

If a biologist today, not long after the turn of the twentieth century and roughly 150 years after the publication of the *Origin of Species*, worked within a Platonic or Aristotelian framework, this would not be in accordance with the general paradigm of today's biology and hence this would place her or him outside of the scientific community.

Still, our historical investigation is not beginning with the rise of Darwinism and its sub-paradigms, but with ancient, mediaeval and modern philosophical predecessors in the philosophy of nature.

This approach is obviously opposed to the historically innocent, almost ignorant, view uttered by an important author of the present debates that "all attempts to answer the question before 1859 are worthless and that we will be better off if we ignore them completely."[210] Many historians, like, for example, Bowler, Cunningham, Depew, v. Engelhardt, Greene, Jardine, Rehbock, Richards and Weber, and also philosophers and biologists, like Weingarten and even Mayr, seem to have a different opinion.

By an historical account which goes back much further than 1859 we will gain a deeper understanding of Darwinism, for example its distorted Christian-Newtonian underpinnings and its Pan-Adaptionism. Moreover we may broaden our horizons in regard to alternative biological accounts. The Darwinian paradigm-shift had no doubt brought improvements, but did it improve evolutionary theory in *all* respects? Even the early history of the philosophical notions of nature may enrich us by its great variety of concepts, from which we perhaps could learn something. A historically informed view may be advantageous when defining controversial notions and when aiming to understand larger contexts of current debates.

In this chapter, as already mentioned, we will not differentiate between an external and an internal history, because biology only later becomes separated as a discipline.

3.1 The Ancient Views of φὐσις – Nature as Organism

Western thought rises in ancient Greece. There are, of course, also interesting non-Western conceptions of nature. For example, earlier than all western accounts the book *I Ching,* the Chinese 'Book of Change', handed down to us by Confucius (c. 551-479 BC), gives a dynamic account of Nature, Cosmos and Humankind.

I concentrate on Western philosophies, first, because of the limited space of this overview, secondly, because of my lack of knowledge of non-Western philosophies and, thirdly, because of the predominant influence of Western thought on science. Nonetheless, a more complete treatment would need to cover other traditions as well.

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[210] G. G. Simpson, quoted in R. Dawkins, *The Selfish Gene* (1976/1989), p. 1. This corresponds to the view that 'the growth of biological thought' is largely the story of Darwinism's triumph over alternative explanations. R. Dawkins, *Universal Darwinism* (1983), p. 403.

a) From Myth to the Pre-Socratics – The Development of Basic Notions

Greek thought dawns in a *world of magic and myth*. In its beginning all 'things' were alive and animate. The Greek tribes (like presumably most other tribes of prehistoric and early recorded historic) were surrounded by forces and ghosts of nature, present in the earth, the sea, the trees and the wind. In Greece these primordial dark forces became more and more personified, firstly in the pre-Olympian, still matriarchal goddesses like Gaia (goddess of the earth), then in the bright, heavenly, anthropomorphic Olympians. This living and animate nature (*hylozoism*) could still be studied in the writings of Thales' (c. 624-546 BC): "pánta plére theon eínai" (all is full of goddesses). To Anaximander (c. 610-545 BC) the abstracted essence of being was the *Apeiron*, the indefinite, infinite, and unlimited origin of the universe, which is taken to be the source of all properties and all becoming.[211] The magic and mystical forces at the dawn of Greek thought were believed to be dynamic and 'fluid'.[212]

Although today's neo-Darwinian view of nature is also dynamic, the magic and mystic intuition at the dawn of Greek philosophy does not only differ in the methodological respect, but was a dynamics of an 'enchanted' nature, alive as a whole, including storms and planets. It was not a dynamics of mechanical clockworks or puppets of 'selfish genes', which in turn are programmed by an eternal law of nature or a simple algorithm of mutation and selection.

It appears that the *very first philosophical approaches* to φύσις (*physis* = nature) gave direction to the further intellectual development. This might to a certain extent be interpreted as an unfolding of ideas which in a different way has already been present in the beginning. I will formulate these ideas as three antitheses spanning the coordinate geometry of western philosophy of nature.[213]

(1) Matter and form: the mentioned philosophers of Miletus in Asia Minor, Thales, and in a way also Anaximander, focus on the 'material', οὐσία, as the essence of being. The Phythagoreans in contrast have formulated an antithesis by focusing on the laws of number and form, ordering matter.

(2) Being and becoming: Heraclitus (c. 544-484 BC) believed that everything is flowing (πάντα ϱεί); whereas the Eleatic Parmenides (c. 540-470 BC) stated that there could be no change at all, but only permanent being.

(3) A resulting third primordial antagonism already present in pre-Socratic thought could be found in the conceptions of Democritus (c. 460-370 BC) opposed to those of Anaxagoras (c. 500-428 BC): the mechanistic philosophy of Democritus could be interpreted as a specific synthesis of the being-becoming and the matter-form antagonism mentioned before. To him the world is built up out of basic elements, out of indivisible 'atoms'. On the one hand elements (matter) appear in a Parmenidian way to be eternal, on the other hand he assumes their combination (form) in a Heraclitian

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[211] A primordial unity of all opposites became a reoccurring motive in the history of philosophy. Cf. J. Hirschberger, *Geschichte der Philosophie* (1948/1991).

[212] K. Gloy, *Das Verständnis der Natur. Die Geschichte des wissenschaftlichen Denkens* (1995), Volume 1, pp. 31.

[213] See the brilliant account by J. Hirschberger, *Geschichte der Philosophie. Band 1: Altertum und Mittelalter* (1948/1991), here reminiscent of a Hegelian account of history.

way to be always in flux. In a similar frame of mind Empedocles (c. 483-425 BC), a predecessor of Democritus, stated an early mechanistic theory of evolution. Anaximander had pronounced a hypothesis of evolution earlier, assuming a development of human beings out of fishlike creatures. Empedocles, and later the Roman Lucretius (97-55 BC), more specifically advocated the survival of viable random combinations as cause of evolution and may hence be regarded as early predecessors of Darwin's specific theory of evolution.

Anaxagoras tries to solve the 'οὐσία versus form'-problem and the 'being versus becoming'-problem in different way. He claims that the basic primordial substances, out of which the world is build, are σπέρματα (*spermata*), germs which have the same essence like their resulting end-product. So although phenomena obviously do change, their essence stays the same. Anaxagoras differed from the later mechanistic monism of Democritus in another way: to him the Spirit (νους) is the origin of motion of the Universe. [214]

After the stage is now set, two main different basic meanings of the concept of nature or φύσις can be detected: firstly the notion 'nature' is used for an all-including Oneness, understood either holistically or atomistically. Secondly, nature is also regarded as a part of this Oneness, and is contrasted with τέχνη (*techne* = culture, art), νους (*nous* = spirit, reason) and νόμος (*nomos* = law, moral).[215] Today we are still aquaintant with these two notions of nature and these antagonisms.

We will see that Plato and Aristotle built their highly influential philosophical systems as a solution of the developments and basic tensions mentioned before.

b) Platonism – Physis as 'Techne'

Plato (427-347 BC) states his philosophy of nature in the *Timaeus,* which was highly influential during the early medieval period and during the renaissance. Although today some aspects of his work may appear shallow or obscure,[216] today's reader could still be impressed by his metaphysics, particularly by his theory of ideas, which is layed out in the influential dialogues, *Politeia, Phaidon, Phaidros and Symposion.*

Plato, like Anaxagoras, opposes a mechanistic and materialistic metaphysics. Instead he advocated a synthesis for the matter-form antagonism, for the being-becoming antagonism and for the physis-nomos antagonism: Behind the actual world, which is changing, he assumes the existence of forms, or ideas (ειδος), which are eternal. The world is molded not by matter in motion but by these forms. The actual, changing world is formed by participating (*metexis*) in an unchanging world of ideas. Later on the actual world has been called *mundus sensibilis* and the world of ideas *mundus intelligibilis*. The factual world is formed rather in a teleological (*causa finalis*) than in a 'causal' (*causa efficiens*) way. All things are striving to reach their end, their *telos* (τέλος), preformed by these eternal forms.

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[214] Anaxagoras has even been interpreted as having written a first Greek manifesto of rational 'creationism'. D. Sedley, *Creationism and Its Critics in Antiquity* (2007/2009).

[215] L. Honnefelder, *Natur-Verhältnisse* (1992), p. 11.

[216] Plato stated that men who have been cowards will be born in their next life as women.

Since the nature (as a whole) is ordered by primordial forms, Plato discusses in the *Timaeus* not only ‘nature’ (φύσις) but ‘cosmos’. This cosmos is created by a demiurge. The demiurge is not the almighty Christian God, who is creating *ex nihilo*, but he is confronted with eternal matter in the state of chaos. This chaos is transferred into the state of order (*cosmos*) by eternal forms, by the *eidos* of the demiurge. In this sense, nature is harmonious, a thing of art (τέχνη ὀν), and designed in a rational way.

Throughout European history of thought, Platonism was not only employed within Christian philosophy to harmonise belief with philosophical thinking, but even the whole European philosophical tradition has been characterised as a series of footnotes to Plato.[217]

c) Aristotelianism – Physis as ‘Autopoiesis’

Aristotle solves the outlined tensions of the early ancient thought in a modified way. With Aristotle (384-322 BC) the form (*eidos/morphe*) came into being *within* the world. Aristotle accused Plato of dividing the actual world and the eternal world of forms/ideas by a gap (*chorismos*): The *one* World is doubled in a perceivable and a true world. Aristotle hence tried to bridge this gap, or even to unite these two worlds again. To him the ideas or forms are immanent *within* the actual things (*eíde en hýle*) and not transcendent or outside of the actual things (*eíde choristá*).

Thus, Aristotle has often been contrasted to Plato. Aristotle is generally regarded as a proponent of a nature, active and creative in itself, a self-organising, autopoietic nature (αυτο = self, ϱοίεσις = making), whereas Plato is seen as a proponent of a made nature (τέχνη ὀν). In the terminology of the scholastics the former proposes a creative nature (*natura naturans*), whereas the latter proposes a creat*ed* nature (*natura naturata*).

> Although the different emphasis of Plato and Aristotle is not in question, it some authors have stressed that similarities of these most influential ancient philosophers are too often neglected: Aristotle, but also Plato, for instance, regarded the whole nature or cosmos as an organism.[218]

Aristotle’s concept of ideas or forms *immanent* in nature, sheds light on his notion of *entelecheia* (ἐντελεχεία): A thing which has reached its telos, within its ‘natural’ form. The notion ‘*entelecheia*’ is also used for a possibility, a tendency of a thing to reach its form. Aristotle advocats a immanent, not a transcendent teleology.

This conception of telos is only understandable in the light of Aristotle’s aetiology[219]. Aristotle distinguishes four causes, or better aspects of explanation[220]: (1) *causa materialis*, the cause of the matter, (2) *causa formalis*, for example, all notions of

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[217] A. N. Whitehead. *Process and Reality* (1929), Part II, Chapter 1, Section 1.

[218] It is being discussed whether this opposition is artificially build up by Aristotle. Aristotle may be seen as a completer of Plato instead. (K. Gloy, *Das Verständnis der Natur. Die Geschichte des wissenschaftlichen Denkens* (1995), Volume 1, pp. 108 ff.)

[219] Aristotle, *Physics* (e.g., Ed. W. D. Ross, 1936/1960), Book II, Chapter 3. The atiology is also expounded in the *Metaphysics* D, 2 and outlined in his zoological books, for example at the beginning and the end of the *De generatione animalium* (e.g., Ed. A. L. Peck, 1943).

[220] The different causes, *aitia*, are not separable causes, but could only in union furnish a complete explanation of natural processes. Ross, *Aristotle’s Natural Philosophy* (1936/1960), pp. 35-36.

species and genera, (3) *causa efficiens,* closest to modern billiard ball causality, and (4) *causa finalis*, the end, goal or telos (τέλος) of something.

> It is often assumed that modern science rejects the concepts of *causa formalis*, and *causa finalis*. I am not going to grapple with the fundamental question, whether this assumption is correct, but it seems at least questionable whether this assumption is true. Clearly, scientists from Francis Bacon onwards have often opposed formal and final causation. However, one may question whether this suffices for a general claim; for instance, it is not completely implausible that the periodic system in chemistry implicitly makes use of the concept of 'ideal forms' or even of some concept of 'teleology' when defining a stable 'state'. Moreover, in some 'subcultures' of biology there have even been explicit attempts to employ Aristotelian philosophy as a source for evolutionary theory. For example, Hans Driesch[221] (a disciple of Haeckel) in the 1920s focused on the concept of *entelecheia.* Humberto R. Maturana and Francisco J. Varela[222] have, since the 1970s, put emphasis on the concept of *autopoiesis* or Rupert Sheldrake[223] has, since the 1980s, developed the concept of *morphogenetic* fields.

Aristotle, coming out of a family where the medical profession was hereditary, was very much interested in philosophy of nature and philosophy of science. In his *physics* (φύσικης), he expounded the aetiology outlined and also critically discussed the notion of chance[224]. Moreover, Aristotle (despite again having predecessors) can justly be said to have founded biological taxonomy or even biology. His main biological books are the *Historia animalum; De partibus animalium* and *De generatione animalium*[225]. He collected many species of animals and by building up a taxonomy he also built up biological theories. Aristotle, for example, focused on reproduction as a major feature to distinguish species[226] and in this respect anticipates schools of modern biology.

We shall touch upon the influence of Aristotle on modern taxonomy again later on (➲ p. 87). In any case, Aristotle's metaphysics has been highly influential for the Western history of ideas.

3.2 Medieval Philosophy – The Divine De-enchantment of Nature

In medieval Europe the ideas of the Judaeo-Christian tradition have become combined with the described Greek traditions into a fruitful philosophical-religious syntesis. This process had several stages: first, the assimilation of Plato's *Timaeus*, then, in the 13th century the influence of Aristotelianism and, finally, a new influence of Plato's rediscovered works.

Instead of discussing the details of these stages, the following subsections focus on important aspects medieval synthesis. Firstly, I shall point out why the combination of Christian and Greek thought had a tendency to undermine itself. Secondly, it will be

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[221] H. Driesch, *The Science & Philosophy of the Organism* (1929).

[222] H. R. Maturana, F. J. Varela, *Der Baum der Erkenntnis* (1984/1987).

[223] R. Sheldrake, *Das Gedächtnis der Natur* (1988/1991).

[224] Aristotle, *Physics* (e.g., Ed. W. D. Ross, 1936/1960), Book II, Chapter 4-6.

[225] Other zoological works of Aristotle are: *De incessu animalium; De anima; Parva naturalia; De motu animalium.* It should be noted that it has been argued that some of the zoological books attributed to Aristotle, e.g., parts of the *Historia Animalium*, show traces of other authors.

[226] Aristotle. *De Generatione animalium* (Ed. A. L. Peck, 1943).

shown that Christian thought, despite the decline of medieval scholasticism, still has substantially influenced modern Western thought, perhaps even in a dangerous way.[227]

a) The World as 'Machina Mundi'

Although it may well seem paradoxical, Christianity presumably was a main driving force for the demystification of nature: Christianity, as a monotheistic religion, banned the goddesses who – according to pagan religions – had animated the trees, the wind and the earth. Even the sun and the moon lost their godlike properties.[228]

Philo of Alexandria (*c.*20 BC - *c.* AD 50) and later on Saint Augustine (354-430) harmonised the Judaeo-Christian myth of creation of the *Genesis* with Platonism, equating God's ideas (which created the world in seven days) with the Platonic concept of *eidos.*[229] God, in this perspective, is the transcendent Creator (*natura naturans*), the actual world and what we call nature a mere result of this creation (*natura naturata*). This modified Platonic view is linked with the idea that we could read the 'book of nature' as one may read the Bible. The phrase 'the book of nature' was coined by Augustine and has given support to design arguments as a potentially rational basis for belief in the existence of God. Nonetheless, Augustine likewise strongly emphasised theological arguments based on revelation.[230]

Thomas Aquinas (*c.* 1225-1274) was predominantly influenced by Aristotelian thought. Nonetheless, nature was not godlike to him either. But nor was nature machinelike to him: nature is *autopoietic,* but not created out of itself, but made by God, who is the *prima causa* and the *summum bonum*.[231]

As Platonic thought became revived at the end of the medieval period, the concept of eternal forms (one might say paradoxically) often was regarded to be coherent with the rise of mechanistic explanations, also referring to eternal, repeatable patterns.

The living nature of the Greeks had by then died. In the translation of Plato's *Timaeus* by Chalcidius, which had a huge impact on medieval thought, the term for the living cosmos was falsely translated as the "beautiful *machine* of the world".[232] Despite such perhaps contingent facts, the demystification of nature seems to follow the inner logic of the synthesis of Greek thought and transcendent Judaeo-Christian monotheism. The world as we enter the period of scientific discovery (➲ pp. 76 f.)

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[227] Lynn White stated as early as 1967 that Christianity is responsible for the environmental crisis. An overview on the controversial discussion about this and its further developments is given by: E. Hargrove, *Beyond the Lynn White Debate* (1986). Without being able to engage in this debate, in my view it is as absurd to assume that the present ecological crisis is a monocausal result from Christian tenets of the 15th century, as it is to assume that Christianity was not presumably *the* most important underlying and changing driving force which moulded both humanism and mechanicism. See e.g., R. Groh, D. Groh, *Religiöse Wurzeln der ökologischen Krise* (1990/1991), esp. pp. 15-16, 35.

[228] Similar: M. Brumlik, *Die Gnostiker* (1992), p. 15.

[229] R. Groh, D. Groh, *Religiöse Wurzeln der ökologischen Krise* (1990/1991), p. 18.

[230] *Ibid,* pp. 22-23.

[231] Th. Aquinas, *Summa Theologiae* (1266-1273/1963-1975).

[232] K. Gloy, *Das Verständnis der Natur* (1995), Volume 1, pp. 157-158, 166.

had already increasingly been seen as a machine (*machina mundi*) following the eternal laws of a transcendent God.

b) The Human as 'Alter Deus'

One of the characteristics of Christianity – and one might cynically add, perhaps one of the main reasons for its wide dissemination in the species of *homo sapiens* – is that its ethics is anthropocentric. 'Love thy neighbour' refers to interhuman ethics, not to ecosystems. But Christianity, of course, does not only advocate the uniqueness of mankind because of an egoistic 'speciesism'. Humans gain this unique position according to the Christian framework, because they are regarded as creatures between angels and beasts. Man is made "in the image of God and after his likeness".[233] Only humans are endowed with some divine properties, like freedom, the *ratio recta* etc.

In late scholasticism, for instance Nicholas Cusanus (1401-64) proclaims man to be an 'alter deus', to be similar to God, especially in his creative abilities. This forecasted the modern idea of the creative genus, although throughout the medieval period it was also taught that one ought to be humble and content with one's providence. Nevertheless, taken a human being as an alter deus builts one of the foundations of the modern emphasis on the individual with unlimited technical abilities. Combined with the demystified nature, this may have been a basis of the often one-sided and destructive realisation of the biblical instruction "subdue the earth and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing."[234].

c) Universalia – From Realism to Nominalism

The emphasis on the creative powers of the *individual* human is paralleled by an important epistemological 'individualisation': A traditional realist understanding of *universalia* would regard types (species), like 'squarehood' or 'doghood'[235], as existing general entities. In contrast, the nominalism predominant in the late medieval period, advocated for instance by William Ockham (*c.* 1285-1348), regarded species as unreal (neither *ante rem* nor *in re*). Universals were taken to be only abstract notions, merely build up in our mind (*universalia in intellectu*).

One may call this an 'individualisation' in two respects: First, the *human being* now individually constructs the world. Accordingly, traditions are less important than before. Secondly, the single *individual entity* or token is real, not the general principle or type.

The outlined concepts of *machina mundi* and *alter deus,* combined with the rise of nominalism, provided the raw material from which most modern philosophical approaches were constructed.

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[233] *Genesis,* 1,26.

[234] *Ibid,* 1,28.

[235] On universals in general, ➲ footnotes 946, 971.

3.3 Modern Philosophy – Nature as Clockwork; Creator as Watchmaker

During the Renaissance the thought of the ancients was rediscovered in all its colourfulness: The books of Plato and Aristotle were again read in their original versions, not only their medieval commentaries. The pre-Socratics, like Democritus, the Greco-Roman traditions of Epicureanism and Stoicism, but also occult traditions, like Cabbalism, gained influence. Within this great motley of Renaissance thought two broad intellectual movements stood out, humanism on the one hand and the rise of natural science on the other.[236]

We will see that these movements still carried on the Christian hidden agenda of the human as *alter deus*, and the universe as *machina mundi.* This is the case although God became less and less important in the course of modern philosophy.

a) The Rise of Science –
The Alter Deus Explores the Clockwork of God: Copernicus, Bacon, Newton

The rise of science corresponded with an increasingly *mechanistic account of nature.* This account was made possible – albeit its differences – by the revival of Platonic thought in the late medieval period and in the Renaissance, combined with an increasing nominalist materialistic understanding of substance.

At least most of the early mechanists, like Newton, still thought that they were completely consistent with theology, because they had revealed mechanisms that were taken to be eternal patterns, the *eidos,* representing the eternal ideas in the mind of god.[237] Driven by the notion of the *machina mundi* of the late medieval period and by the monotheistic de-enchantment of nature, the mechanistic understanding of nature celebrated one victory after another.

In the year of his death, Nicolaus Copernicus (1473-1543), a Polish astronomer and orthodox ecclesiastic, published *De Revolutionibus Orbium Caelestium,* where he elaborated the hypothesis that the earth revolves the sun. Galileo Galilei (1564-1642) gave a unifying mechanical account of falling bodies and of inertia. Johannes Kepler (1571-1630) showed that the movement of the planets is elliptical, which was seen as evidence against the Aristotelian (and Copernican) conception that movement is naturally circular. But in Kepler's view still the Platonic-Pythagorean aspect was more important than the materialistic one; hence he as an astronomer could regard himself a priest of God's book of nature[238].

Francis Bacon (1561-1626), himself Lord Chancellor of England, formulated the subliminal ideology of the flourishing mechanistic science. He banned teleological explanations (*causa finalis*) from science and thereby gave way to modern thought, focusing mainly on *causa efficiens* (causality) and *causa materialis* (matter). "Inquiry into final causes is sterile, and like a virgin consecrated to God, produces nothing."[239]

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[236] D. Cooper, *World Philosophies* (1996), pp. 226-237.

[237] E.g., R. Groh, D. Groh, *Religiöse Wurzeln der ökologischen Krise* (1990/1991), pp. 17 f.

[238] Letter from Kepler to Herwart von Hohenburg, 26th of Mar. 1598. Mentioned in: R. Groh, D. Groh, *Religiöse Wurzeln der ökologischen Krise* (1990/1991), pp. 25-26.

[239] F. Bacon, quoted in J. D. Barrow, F. J. Tipler, *The Anthropic Principle* (1986/1990), p. 49.

Bacon became *the* highpriest of the new science. Bacon turned against Aristotelianism and gave support to Platonism, which then moulded the English philosophy of nature.[240] He continued and accentuated the Christian zeal of the god-like scientist, the *alter deus,* to read in the 'book of nature' and to explore the *machina mundi* so as to change this world. But by dismissing teleological explanations, still central to Platonic schoolmen, Bacon contributed to the transformation of English Platonism into a mechanical Platonism and finally into mechanical materialism.

This outlined early scientific, and philosophical[241], development culminated in Isaac Newton's (1643-1724) paradigmatic book *Philosophia Naturalis Principia Mathematica* (1687). Nature now had become "this vast Machine of the Universe, the wise Production of Almighty God, consisting of a great number of lesser Machines, every one of which is adjusted by the same Wisdom in Nature, Weight and Measure"[242]. The metaphor of the *machina mundi,* which referred at first, in the translation of Plato's *Timaeus* by Chalcidius (➲ p. 74), to the living whole of the universe – '*zoon*' –, has changed its meaning to a dead machine, once made by a divine constructor and now running without any intervention.

In the seventeenth and eighteenth century the plain metaphor that the universe is a clockwork once made by a divine watchmaker became increasingly common.[243] Kepler for example wrote in a letter that his aim is to show that "celestial machinery is not something like a divine living organism, but like a clockwork"[244]. To him, as to Newton and Leibniz these metaphors refer to both a mechanistic universe, but also to the eternal harmony once created by a deistic God, who does not interfere with the actual world after its initial creation.

New science, in its early reading, was taken not to undermine theology, but on the contrary as providing evidence for a more rational theology. In those times of religious struggles, basing theology on a scientific argument of design also seemed to prevent dangerous religious disputes.[245] Accordingly early modern scientists were still often vigorous believers in a deistic, but omniscient, watchmaker, which was much more than today's neo-Darwinian belief in only a 'blind watchmaker'[246].

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[240] Mentioned by R. Groh, D. Groh, *Religiöse Wurzeln der ökologischen Krise* (1990/1991), p. 36.

[241] G. Böhme, *Philosophische Grundlagen der Newtonischen Mechanik* (1989/1993), pp. 278-295.

[242] J. Harris, *Lexicon Technicum* (1704/1710), quoted in J. Mittelstrass, *Leben mit der Natur* (1991/1987), p. 39.

[243] K. Gloy, *Das Verständnis der Natur. Die Geschichte des wissenschaftlichen Denkens* (1995), Volume 1, p. 166.

[244] Original: "Scopus meus hic est, ut Caelestem machinam dicam non esse instar divinj animalis, sed instar horologij" (translation by the author). Letter from the 10th of Feb. 1605. Mentioned in: M. Caspar, W. von Dyck (Ed.), *Johannes Kepler in seinen Briefen* (1930), p. 219 (quoted in K. Gloy, *Das Verständnis der Natur. Die Geschichte des wissenschaftlichen Denkens* (1995), Volume 1, pp. 166, 311.).

[245] R. Groh, D. Groh, *Religiöse Wurzeln der ökologischen Krise* (1990/1991), pp. 31-34, 46.

[246] R. Dawkins, *The Blind Watchmaker* (1986/1991).

b) Humanism – The Alter Deus Replaces the Christian Deus

The second aspect of Christian dogma shaping modern thought is its humanism. The humanistic belief in the value of the human being has been linked to the Christian belief in the inherent worth of the human, as being created in the image of God. Accordingly humans are regarded as creatures between beasts and divinity. In the Renaissance the notion of the human as the *alter deus* had even be radicalised, by emphasising the free and god-like human ability to create and change the physical world.

Mankind has the right and the duty to understand and to creatively change the mechanical world, to make use and even to exploit nature. Correspondingly early scientists and engineers explore nature and, based on this knowledge they invent machines. Between 1550 and 1750 there was a flood of so-called machine books, optimistically linking descriptions of constructions with theological or philosophical instructions. Here the argument of design was used the other way round, the mechanist, the engineer is constructing machines in analogy to the creating God.[247]

Hence as early modern science is linked to the Christian notion of *machina mundi,* the technical construction of machines is linked to the notion of the *alter deus.* These two developments are in the further course of history still interacting: on the one hand the understanding of the laws of God's nature built the basis for building machines, on the other hand the metaphor of *machina mundi* will become reformulated in terms of machines current at certain times (e. g. clockwork and today, perhaps, computers).

Moreover, the predominant belief in the value of the human being served and still serves as a basis of most systems of Western ethics. Although the notion of God through Reformation, deism, agnosticism and atheism had been increasingly removed from the modern *Weltbild,* the idea of human value is still with us. The *alter deus,* with all his creativity and freedom, replaced the *deus* of Christianity. Humankind has followed the Christian demand and became almost god-like. We learned to create nearly everything: materials, machines, artificial environments like houses and, today, by genetic engineering even organisms and, in principle, humans themselves. Hence, there seems to be less and less need for the notion of God as creator.

By means of this removal of the Christian god, modern philosophy became confronted with two fundamental problems:

(1) Ethics increasingly emphasised the notion of the *alter dues,* the human individual. Today the partly divine human nature, and therefore its ethical value, has come under attack (➲ already pp. 51). We recognise an irony of history: The Christian belief in human value is, by realising its consequences and by replacing God, in danger of undermining itself. – It is one main modern task to build an ethical system not based on God, but on reason. This can be seen as trying to build humanism independently of its own original basis. The alternative would be to build it on reasoning, which is of course itself a very humanistic notion with its own religious inhertance. Paradoxically, philosophers of the enlightenment, often involuntarily, saved and carried on the Christian (and modern) hidden agenda to emphasise the unique human value.

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[247] R. Groh, D. Groh, *Religiöse Wurzeln der ökologischen Krise* (1990/1991), p. 60.

(2) Ethics is under attack from the – also Christian based – belief in a mechanic universe. If the first problem, to give reason for the value of the human and humane, is not solved, an inclination arises for the mechanistic view of nature to be also applied to humanity itself. Hence the balanced dichotomy of mechanistic nature on the one hand and partly divine human nature on the other is in danger of collapsing into a mechanistic monism. This mechanistic approach would exactly destroy that value, which it once aimed to support. It was especially Darwin who will move the boundaries between *machina mundi* and *alter deus*, as he gave a largely mechanistic account of biology and at least the origin of humankind.

Early modern philosophical accounts have still tried to keep the balance of the concept of human uniqueness and the concept of a mechanistic universe. Descartes' dualistic philosophy can be regarded as the first modern attempt to combine, on the one hand, the increasingly mechanistic assumptions of physics and astronomy, and, on the other, the uniqueness of the human and humane.

c) Descartes and Kant – Dualism of Human Freedom and the Clockwork of Nature

René Descartes (1596-1650), educated at the Jesuit college of La Flèche, is normally seen as 'the father of modern philosophy', and, despite generations of further predecessors, I think rightly. His first, and he thinks undeniable premise after all his Cartesian doubt, is the '*cogito ergo sum*' – not God. Although Descartes 'proves' the existence of God in the second step, it is important that in the first step it was possible for him, to start with the assumption of an evil deceitful demon, who was using his powers to voluntarily mislead the one how seeks for the truth.

The absolute certainty of the *cogito,* of the "I doubt, therefore I think, therefore I am", paradoxically carries on the Christian belief in the uniqueness of the human being. However, in its modern subjectivist form this belief is completely altered, we cannot be sure in our individual value because of God, but because we daubt everything including God. Following his argument, the first thing one can conclude from the *cogito* is that there is a *sum,* in Latin this means 'I' characterised by its thinking. If we are thinking, the first thing which is necessary given is a 'thinking thing' (*res cogitans*). It is crucial that this thinking thing is defined completely independent from the body.

The second key notion of Descartes' dualism is the material 'extended thing' (*res extensa*). Descartes gives the example of wax, which loses its qualities when it is heated. According to Descartes this example shows that qualities are changing and only matter, whose essence is extension, persists. Descartes, himself also a significant mathematician and scientist, shared the mechanical and deterministic view at which the physics and astronomy of his time had arrived. In *Le Monde* an early treatise of him on physics, he had already abandoned the scholastic concept of form. The complete transformation of Platonism resulted in a mechanistic, atomistic approach applied to all 'things' apart form the human *res cogitans*. Descartes "regarded the bodies of men and animals as machines; animals he regarded as automata, governed entirely by the laws of physics, and devoid of feeling or consciousness. [...] If we knew enough, we should be able to reduce chemistry and biology to mechanics; the process by which a seed develops into an animal or a plant is purely mechanical."[248] By this the Aristotelian idea of *entelecheia* and self-organisation (*autopoiesis*) had been ruled out – as is important in this context – also in biology.

The Cartesian position, like other dualist philosophies of a free mind and a determined body, implies – driven by the dyadic notions of the *alter deus* and the *machina mundi* – two of the most grave modern philosophical problems.

(1) Starting from the side of *alter deus* or *res cogitans*, how could the gulf to the *machina mundi* or *res extensa* be bridged? This is the radicalised modern question of epistemology and truth.

(2) Starting from the side of *machina mundi* or *res extensa,* how could the gulf to the *alter deus* or *res cogitans* be bridged? This is the main modern question of ontology, anthropology or, more precisely, the modern mind-body problem.

Immanuel Kant (1724-1804), the most significant philosopher of the enlightenment, carried on Descartes' approach to save ethics in a deterministic Newtonian phenomenal world, by giving it a subjectivist turn. Kant "found it necessary to deny knowledge, in order to make room for faith"[249]. He went on with David Hume's (1711-76) sceptical answer to the epistemological question, which Hume applied even to causal explanations in general, the core of the prevailing Newtonian physics. Kant agreed with Hume that we could not conclude from mere associations on a causal structure of reality. He states that although there is something out there, it is basically not possible to get knowledge about the 'thing in itself' *(Ding an sich*).

But Kant again retained some features of the world of appearances by his conceptual shift, similar to the shift of Copernicus, who found that we should seek "the observed motions not in the heavenly bodies, but in their observer"[250]: To Kant space and time are still existent in the sense that they are necessary conditions of our sensibility. Causality, likewise, is a necessary notion to make our experience possible. Kant calls this type of notion 'category' ('*Kategorie*' or '*Verstandesbegriff a priori*').[251] With his subjectivist stance, at least in an epistemological sense, Kant is part of the individualistic current of his time, which has – as we have seen – reaches back to the veneration of the human being as *alter deus*. However, by his subjectivist stance Kant distances himself from the deist Newtonian view, that the eternal mathematical clockwork of nature is created by God, as clockmaker. To Kant the rational being – the human – 'creates' God, as an 'idea of reason' only imposed by us to the world. These ideas of reason could neither be proved, nor disproved.

Besides the subjectivist approach Kant also shares with Descartes some sort of dualism. In his third critique '*Kritik der Urteilskraft*' he gave an outline of his whole 'transcendental' philosophy: Accordingly philosophy is divided into two distinct parts;

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[248] B. Russell, *History of Western Philosophy* (1946/1961/1991), pp. 545-546.

[249] I. Kant, *Kritik der reinen Vernunft* (1781/1787), B, p. XXX. Original: "Ich mußte also das Wissen aufheben, um zum Glauben Platz zu bekommen" (translation by the author).

[250] *Ibid,* B, p. XXII. Original: "die beobachteten Bewegungen nicht in den Gegenständen des Himmels, sondern in ihrem Zuschauer" (translation by the author).

[251] *Ibid,* A, p. 80, B 106.

practical philosophy, which is based on our knowledge *a priori* of the moral law and our freedom and theoretical philosophy, which is based on our knowledge *a priori* of nature.[252] The border between the worlds of practical and theoretical reason now cuts through the single subject: the totally causally determined self within the physical world and the self as a completely free rational being.

Kant in the second part of the *Critique of Judgement* tries to bridge the gap of these two approaches in his philosophy of biology. Although Kant in his theoretical philosophy had come, despite his subjectivist-logical turn, to similar results to Newton's, and phenomena (not *noumena* or *Dinge an sich*) were regarded as moving causally determined (*causa efficiens*) and machine-like in space and time, Kant in the third critique – at least to some extent – also re-established the notion of teleology (*causa finalis*) as an organising (regulative) principle, which connects our knowledge of nature and of moral truth.[253] Hereby Kant's philosophical account of biology, partly inspired by the reading of J. F. Blumenbach, turned against an exclusively mechanistic picture of the organism. Organisms are both their own cause and effect. The parts of an organism are according to Kant only understandable when referring to the whole: different from a clock they exist not only *for* the other parts of the whole, but *because* of the other parts.[254] Teleology, in Kant's view, helps us to structure our perception of the deterministic nature for the use of practical philosophy. But to Kant this *regulative* principle is only a useful intellectual tool to structure the multitude of appearances, not like causality a *constitutive* necessary one.[255] (For example, – according to Kant – it is reasonable to say that the photosynthesis is a means to the end of supplying energy for the plant's metabolism. Nevertheless any understanding will be fundamentally also be causal.)

In summary then, in Kant's transcendental philosophy, with his great new answer to the epistemological problem, the concept of *machina mundi* is carried on within theoretical reason by the mainly causally determined universe of appearances, and the concept of the *alter deus* is in a sublime way carried on by the freedom within practical reason. He tries to make both realms compatible by introducing teleology as a regulative idea. Hence, it has been possible to Kant to be impressed by both, "the starry heavens above me and the moral law within me"[256].

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[252] I. Kant. *Kritik der Urteilskraft* (1790/1793/1799), pp. XVI-XX.

[253] *Ibid,* Part II.

[254] Mentioned in: M. Weingarten, *Organismen – Objekte oder Subjekte der Evolution* (1993), pp. 18, 21-22. R. J. Richards, *The Meaning of Evolution* (1992), pp. 22 f.

[255] I. Kant, *Kritik der Urteilskraft* (1790/1793/1799), p. 270.

[256] *Idem*, *Kritik der praktischen Vernunft* (1788), pp. 288-289. Original: "der bestirnte Himmel über mir und das moralische Gesetz in mir" (translation by the author).

d) Idealism and Romanticism – The Dynamic Trial of a Unification

"It is One force, One interplay and weaving. One drive and impulsion to ever higher life."

Schelling, 1800-1801.

(i) 'Naturphilosophie' and Idealism

Building on Kant's conception that all appearances (phenomena), are formed by our own sensibility, understanding and reason, and on Kant's conception of the freedom of (practical) reason, the *philosophers* of German Idealism changed and radicalised Kant's approach completely. Inspired by Spinoza, they tried to give a unified account of what Kant had torn into two pieces. They eliminated the 'thing in itself', and built up a pure (transcendental) *Geistesphilosophie,* which should comprise both parts, nature and what we might call human *logos* or *nous.*

Johann Gottlieb Fichte (1762-1814) starts in his main work, *Wissenschaftslehre,* with the I (*Ich*). The first necessary distinction is that the absolute I sets the 'Non-I' (*Nicht-Ich*), and by this also a 'remaining' I.[257] This is the distinction of world and self, which all of us experience *within* ourselves.

Friedrich Wilhelm J. Schelling (1775-1854) turned this subjective Idealism of the young Fichte, into an 'objective' one. Influenced by Spinoza's pantheistic idea of the *Deus sive Natura*, God is to Schelling the absolute I. This 'I', the 'I' of God or of the whole of primordial nature, develops against its own resistance, in opposed forces of productivity (*natura naturans*) and inhibition (*natura naturata*), throughout all stages of nature and human reason. To Schelling nature has been alive from its very beginning, and it is rather the permanent than the change which needs to be explained. Nature is not a machine but an organism and a soul. This approach radicalised Kant's criticism of an exclusively mechanistic account of the biological world, a criticism also present in the accounts of the early *Naturforscher* Blumbach, Wolf and Kielmeyer.[258] Schelling already advocated an unfolding of nature, an *evolution* in the much more original sense of the word (*ex-volvere*), although he emphasised an idealised, theoretical and partly *a prioric* conception, and not an empirical one. This (ideal) development culminates and has its end in humanity, where nature comes to consciousness.[259]

Schelling's objective idealism and also Johann Wolfgang von Goethe's (1749-1832) holism strongly moulded the idealist or romantic understanding of nature. The poetic movement of romanticism was also influenced by Kant and the romantic philosophers. For example, the English romantic poets Blake, Wordsworth, Coleridge,

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[257] J. G. Fichte, *Grundlage der gesamten Wissenschaftslehre* (1794), I., p. 104.

[258] T. Lenoir, *The Göttingen School and the Development of Transcendental Naturphilosophie in the Romantic Era.* (1981). R. J. Richards, *Meaning of Evolution* (1992), p. 28. Th. Bach, *Kielmeyer als 'Vater der Naturphilosophie'?* (1994); B*iologie und Philosophie bei C. F. Kielmeyer und F. W. J. Schelling* (2001).

[259] Important works of F. W. J. Schelling's early period, during which he exponded his *Naturphilosophie* were: *Ideen zu einer Philosophie der Natur* (1797), *Von der Weltseele* (1798/1806/1809), *Erster Entwurf eines Systems der Naturphilosophie* (1799).

Keats, Byron, Shelley and Scott – albeit speaking a more poetic language – share many views with these philosophers.[260]

The *notion of romanticism*, like most interesting abstract notions, is at once indispensable and misleading. There are many different meanings of the term, slightly differing from literature to the sciences, from country to country. Often especially in the English speaking countries 'Romanticism' is used in a quite broad sense, closely linked to the work of Rousseau, the rise of objective idealism, to the work of Schelling, Hegel and Goethe. Historically speaking the period between 1790-1830 and into the 19th century is meant.

But although I am also going to use 'romanticism' in this broad sense, it has to be noted that Goethe, for example, never considered himself a Romantic. German history of literature traditionally distinguishes between *Klassik*, and *Frühromantik, Hochromantik, Spätromantik*. Kant although often subsumed under romanticism in this broad sense[261], conceptually and in stile was at odds even with the idealists who abandoned any 'thing in itself'. Also his sober style contrasts with the rather poetic romantics. Also Hegel actually turned against Romanticism in its more strict sense. There are also other terms to cover a more specific meaning not so closely linked with the strongly poetic attitude of the Romantics, like *Naturphilosophie*, German idealism, morphology etc.

Still the broad meaning of Romanticism, is useful to contrast the sketched *Naturphilosophie* against a purely mechanistic approach to Nature. Later on we will distinguish different schools of biology (➲ see also pp. 92 f.).

Also some *scientists* had been strongly influenced by idealist or romantic approach to understand nature. Romantic *Naturforscher* (literally: investigators of nature) actually played, as historical research has shown, an important role in the so-called 'Second Scientific Revolution'.[262] Romantic scientists, like the physicists Johann Wilhelm Ritter[263] (1776-1810) and Hans Christian Ørsted[264] (1777-1851), the chemist Humphry Davy[265] (1778-1829) and to a certain extent his assistant Michael Faraday, the biologists (➲ pp. 95 f.) Lorenz Oken (1779-1851) and Joseph Henry Green (1791-1863), the geographer Alexander von Humboldt (1769-1859) and many others were crucial in founding and inspiring many of our today's disciplines. "We can no longer simply assent to Justus von Liebig's view that *Naturphilosophie* was the Black Death of the nineteenth century."[266]

Besides a new scientific approach, the ideal of *Bildung* was the other basis of the central role of Romanticism in the Second Scientific Revolution. Especially in Germany there was a "radical call for '*die Neuerschaffung der Universität aus dem Geist des deutschen Idealismus*' ('the new

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[260] There is much material on this topic. E.g., M. Sherwood, *Undercurrents of Influence in English Romantic Poetry* (1934/1971).

[261] A difference in usage is annotated e.g., in D. v. Engelhardt, *Wissenschaft und Philosophie der Natur um 1800* (1994), p. 257. For examples of a broad usage see: A. Cunningham, N. Jardine, *Romanticism and the Sciences* (1990). A. Quinton, *Philosophical Romanticism* (1995), p. 778.

[262] This is the thesis of A. Cunningham's and N. Jardine's anthology *Romanticism and the Sciences* (1990), pp. 1-9. See also D. Knight, *Science in the Romantic Era* (1998).

[263] W. D. Wetzels, *J. W. Ritter: Romantic Physics in Germany* (1990).

[264] There is a new edition and translation Ørsted's writings: L. Horner, J. B. Horner (Ed.), *Soul in Nature with Supplementary Contributions* (1966), ➲ footnote 270.

[265] Ch. Lawrence, *The Power and the Glory: Humphry Davy and Romanticism* (1990). D. Knight, *Humphrey Davy: Science and Power* (1992/1998).

[266] D. Knight, *Romanticism and the Sciences* (1990), p. 22.

> creation of the university out of the spirit of German idealism')." The discussion about the new creation of the university started from the "first principles, and extended from the nature of *Bildung*"[267]. The philosophers, Schelling, Fichte, Friedrich Schleiermacher (1768-1834), Wilhelm v. Humboldt (1767-1835), Friedrich v. Schiller (1759-1805) and also Kant, most of them at least associated with idealism or romanticism, played the leading role in this movement, also in practical terms, founding the new Humboldt University of Berlin.[268] Romantic ideas have also been influential on the founders of London University and within the United States.[269]

Some of the previously mentioned scientists, like Ørsted, are utterly critical of the obscure and sometimes, in their view, false way Schelling used empirical propositions.[270] Because of this and because of their at least partly empirical orientation, it seems sensible to distinguish Romantic *Naturforschung* and *Naturphilosophie*[271]. Apart from this, the romantic scientists share with romantic philosophers their basic tenets. By introducing these tenets into science, they have already favoured evolutionism (➲ pp. 95 f.) and paradoxically at least prepared the ground for Darwinism, which then vigorously attacked the remaining Romantics.

(ii) Unity, Dynamism and Organicism

Now three defining aspects of Romantic *Naturphilosophen* or *Naturforscher* shall be outlined.[272]

Unity: To Romantic philosophers and Romantic scientists, following Spinoza's conception of one substance, the idea of ultimate unity of the world (and by this of the absolute I, of god) was central: they claimed that there is an unity of nature and culture, a unity of mind and body, a unity of forces, a unity of body plans and a unity of the scientific and the artistic enterprise.

Nature and culture are not the opposed realms of necessity and freedom. Nature and culture are both alive and organic, they are one unity, developed out of the same origin, understandable with the same historico-genetic method. Advocates of objective idealism advocated a necessary 'logical' unfolding of *logos*. Corresponding to these tenets the Romanticists and Idealists also tried to unify the subjective (knowledge) and objective (nature) side of consciousness.[273] Owing to this urge for unity many of the leading Romantic scientists were both scientists *and* artists or philosophers, like Davy, Goethe, Oken and Ritter. One of the features which commonly drove the romantic scientists was this urge for unification and the search

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[267] E. S. Shaffer, *Romantic Philosophy and the Organization of the Disciplines [...]* (1990), p. 38 (both quotes).

[268] In the ideas of university and *Bildung* the other romantic tenets are recurring: the concept of freedom of thought recurs in the concept of scientific freedom; the ultimate unity of all knowledge recurs in the concept of a university with all subjects, with the central unifying subject of philosophy and in the unity of teaching and research.

[269] E. S. Shaffer, *Romantic Philosophy and the Organization of the Disciplines* [...] (1990), pp. 39-40.

[270] H. A. M. Snelders, *Oersted's Discovery of Electromagnetism* (1990).

[271] Similar: D. v. Engelhardt, *Historical Consciousness in the German Romantic Naturforschung* (1990), p. 56.

[272] Similar: M. Heidelberger, *Naturphilosophie* (1998), p. 739.

[273] D. v. Engelhardt, *Historical Consciousness in the German Romantic Naturforschung* (1990), p. 56.

for a uniting force behind different forces. With the discovery of electromagnetism Ørsted united the previously separated physical forces electricity and magnetism; Ritter discovered that ultra-violet rays belong to the electromagnetic spectrum; Davy could introduce the fundamental conception of chemistry that chemical affinity and electricity are manifestations of one power. The tenet that all force is one "led some men of science in the next generation towards the conception of conservation of energy"[274].

> In all fields of thought, and also in applied areas as education and politics the Romantic tenet of unity was present. For example in politics Fichte was one of the main promoters of the unity, still limited, of Germany and the biologist Oken got involved in the *Wartburgfest,* a political feast for German freedom and unity.

Dynamism: The unity of nature and culture is essentially complemented by the idea of a new and common history of nature and culture.[275] The "unfolding of a generative history of nature through an 'original intuition'"[276] is the aim of Schelling's *Naturphilosophie*. Similar approaches were taken by the late Fichte, Friedrich Hölderlin (1770-1843), Novalis (Freiherr v. Hardenberg, 1772-1801) and Johann Gottlieb v. Herder (1744-1803).

Although Schelling had not built up an empirical but an ideal or transcendental evolutionary scheme, this ideogenesis or 'dynamic evolution' built the intellectual foundation for the application of the historical-genetic method in science and art, and the theory of descent within biology and for evolutionism and transformism in general: "The eighteenth century begins to perceive nature as subject to change."[277] Many cosmological and geological studies state the transformation of nature, which suggests the transformation of the animated nature as well.[278]

Idealist and romantic biology emphasised both the notion of form or body plan *and* the notion of transformation (for details ➲ pp. 95 f.). Many idealist and romantic authors (e. g. L. Oken, C. G. Carus, G. R. Treviranus, F. Tiedemann, J. F. Meckel and E. R. Serres, and already K. F. Kielmeyer and J. H. F. Autenrieth) combined these two notions within the concept of a recapitulation, that embryos of higher animals pass through stages of lower animals. Embryogeny repeats zoogeny. This concept of recapitulation, the 'law of parallelism' or Meckel-Serres law became closely bound to the notion of 'evolution'.[279]

In 1801 Henrik Steffens (1773-1845) explicitly speaks of "a 'theory of evolution', but in the sense of an idealist"[280]. The romantic palaeontologist Georg August Goldfuss (1782-1848) argued 1826 in favour of an actual metamorphosis of the

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[274] D. Knight, *Romanticism and the Sciences* (1990), p. 21.

[275] Similar: D. v. Engelhardt. *Historical Consciousness in the German Romantic Naturforschung* (1990), p. 63.

[276] A. Cunningham, N. Jardine, *The Age of Reflexion* (1990), p. 5.

[277] D. v. Engelhardt, *Historical Consciousness in the German Romantic Naturforschung* (1990), p. 56.

[278] *Ibid,* p. 57.

[279] For a detailed accout of these recapitulation theories, and their influence on Darwin, see R. J. Richards, *The Meaning of Evolution* (1992), esp. Chapter 3, 4, 5 and p. 47.

[280] D. v. Engelhardt, *Historical Consciousness in the German Romantic Naturforschung* (1990), pp. 57 f.

animal kingdom, "similar to that of the foetus, its periods being contemporary with the formation periods of the globe."[281] "It cannot be overemphasised that the task of *Naturphilosophie* was primarily historical, and Oken's definition makes this patent. *Naturphilosophie* had to demonstrate how the universe originated, and to reconstruct its development or *Entwicklung* from the original Idea thought by God to its highest manifestation as man."[282] This concept of an *Entwicklung,* of an 'evolution' is a deeply romantic one, which Darwin, surely did not invent but only changed and connected with other concepts (➲ pp. 163 f.).

Organicism: A third important tenet of romantic *Naturforschung* is the analogy between Nature and developing organisms: the gestation of nature. The romantics certainly were hostile to the enlightenment's mechanical account of nature. The whole is taken to be more than an accumulation of parts. In morphology, *Naturforscher* emphasised the notion of the archetype (present in Kant's *Critique of Judgement*) searching, like Goethe, for unifying body plans. To Kant and even more to the idealist and romantic *Naturforscher* organisms are their own sources of activity, with a formative active striving, a Blumenbachian-Schellingian *Bildungstrieb.* Nature is not a mechanism, but alive, or a "slumbering spirit".[283] In the poems of the great romantic chemist Davy "nature is not 'it' but [...] 'she'; personified and active, '*natura naturans*' rather than '*natura naturata*', in progress rather than complete: God is working his purpose out."[284]

(iii) The Breakdown of Romantic Science

Apart from the massive sublime influence of Romanticism on science, generally Romanticism has finally failed its quest to build up a unified, holistic framework of human knowledge. The positivist account seized power in science in general and also in biology. Of course, we know today – and this has been long ignored[285] – that even positivist accounts were strongly influenced by Romanticism. Especially the belief in the ultimate reality and unity of forces and also the dynamic account of nature and culture became accepted basic assumptions in science and art. Still, apart from these influences, the different positivistic, mainly mechanistic paradigm took over.

But why then had Romanticism and Objective Idealism failed? Although the answer is presumably highly complex, I will try to provide a provisory one: I think Romanticism and Objective Idealism were from their beginning basically one-sided. Despite the romantic aim to unify, to synthesise the (seemingly) opposed realms of subject and object, of 'I' and world, of nature and culture, Fichte and later Schelling built their systems only on one of Kant's 'two worlds': they mainly built their system on the side of the freedom of reason, on the side of the transcendental I. Although it might be their merit to emphasise the necessity of (a priory) *rational* construction

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[281] G. A. Goldfuss, *Grundriss der Zoologie* (1826), p. 33.

[282] E. Richards, *The Romantic Gestation of Nature* (1990), p. 132.

[283] F. W. J. Schelling, *Ideas for a Philosophy of Nature* (Ideen zu einer Philosophie der Natur), (1788/1997), p. 42, quoted in D. Cooper, *World Philosophy* (1996), p. 310.

[284] D. Knight paraphrasing P. Piper. D. Knight, *Romanticism and the Sciences* (1990), p. 14.

[285] A. Cunningham, N. Jardine, *Romanticism and the Sciences* (1990).

within science, at least some proponents of this approach underestimated the importance of *empirical* testability. Because of this, many concepts, especially the transcendental constructions of the genius Schelling, 'lost ground' and became cryptic. Romanticism became dominantly "poetic and aesthetic"[286] and in parallel many different creative ideas arose. Even Science was pluralistic and speculative. Novalis declared: "The ways of contemplating nature are innumerable"[287]. At its worst, 'facts' of science were ignored: D. H. F. Link, "a most respected *Naturforscher* [...] complained that the *Naturforscher* had been advised to forget everything he had learned."[288] Because of these reasons Th. H. Huxley – the bitter enemy of Owen –, who became "probably the single most influential and destructive English-speaking critic of the 'metaphorical mystifications' of '*Naturphilosophie*' opposed sharply the 'wild-eyed speculations', 'oracular utterances' and general verbal gymnastics of the unruly Romantics".[289]

Still, Objective Idealism and Romanticism founded an impressive body of speculation and knowledge, and in my opinion it was wrong to dismiss this current altogether. True, I do not see a straight way back to this paradigm, but we may still regard this paradigm as an old sunken treasure, containing perhaps not only false strings of pearls. Especially in biology we might find conceptions (➲ pp. 95 f.), which have been neglected by the mainly mechanistic account of the positivist successors.

Moreover, ideas of romanticism moulded the epochs to come, even long after the end of the Romantic era.[290] However, on the side of philosophy romanticism got deprived of its central idealistic assumptions and was changed to a hollow dynamism, found in the philosophy of will and then in the philosophy of life. On the side of science the concept of evolution was carried on, but in an increasingly different positivistic and mechanistic framework.

3.4 The Rise of Biology as Science – Torn between Eternal Form and Evolution

Aristotle founded European biological taxonomy and biology two thousand years earlier than Linnaeus and he was highly influential not only during the medieval ages but at least till the 18th century. For example, only Lamarck renamed Aristotle's classification of all animals into 'blooded' and 'bloodless' as 'vertebrates' and 'invertebrates'.[291] Aristotle's general philosophy has already been mentioned before (➲ p. 72), and here only his influence on taxonomy will be mentioned.

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[286] *Ibid,* p. 5. See also: N. Jardine, *Naturphilosophie and the Kingdoms of Nature* (1996), p. 232.

[287] Novalis. *Werke* (Eds. H.-J. Mähl, R. Samuel, 1978-1987), Vol. II, p. 234. (Quoted in: N. Jardine, E. C. Spray, *Natures of Cultural History* (1996), p. 4.)

[288] S. R. Morgan, *Schelling and His 'Naturphilosophie'* (1990), p. 35.

[289] E. Richards, *'Metaphorical Mystifications': The Romantic Gestation of Nature in British Biology* (1990), p. 130.

[290] Cf. R. Safranski. *Romantik* (2007).

[291] E. Mayr, *The Growth of Biological Thought* (1982), p. 152.

Aristotle had already described more than 500 species and arranged them in his *Historia animalium* (History of Animals) hierarchically along what was later called the *scala naturae* (Great Chain of Being). He had also included man among the *quadrupeds*.

After translations of Aristotle's zoological works from Arabic[292], scholastic 'biologists' from the thirteenth century on were strongly influenced by Aristotle. But they passed over the dynamic and reproductive aspects of Aristotle's theory. The scholastics emphasised our proximity to angels and removed humans from nature.[293] So it is important to distinguish between the ancient, and the mediaeval Aristotle. The scholastics transformed Aristotle's hierarchical taxonomy into a linear Great Chain of Being, with its origin rather in God than in matter, normally conceived in a completely static sense.[294]

It was only in the eighteenth and early nineteenth century that *biology* emerged *as a specialised science*. Although Linnaeus and Buffon made important steps in building up this science, they were both still general naturalists, also working on the kingdom of minerals and on geological development.

Around 1800 several authors independently announced the birth of 'biology' as a new scientific discipline. The term 'biology' emphasised a specific methodology for studying organisms and was coined in contrast, on the one hand, to mere descriptions or classifications of nature and, on the other hand, to the exclusive mechanistic account predominant in physics: In 1797 Roose and in 1800 Burdach[295] coined this term. In 1802 Treviranus announced the birth of a new scientific discipline[296] and almost in parallel, Lamarck made a similar application of the term 'biology'.[297]

It is difficult to structure the manifold different biological theories of that time – a time before the regime of Darwinism gave biology a unifying framework. Although many disputes are often described dichotomically, I think it is reasonable to distinguish at least the following three dominant groups:[298]

(1) Romanticising *Materialistic Biology*, focusing on the transmutation of species or organisms.
(2) *Transcendental Biology*, with the central concept of a necessary form or structure of an organism.

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[292] Only briefly mentioned by A. L. Peck in his introduction of Aristotle's *De partibus animalium* (1937), p. 10.

[293] L. Schiebinger, *Mammals, Primatology and Sexology* (1994), pp. 186 f.

[294] D. Dennett proposes the metaphor of a chandelier hanging from God: *Darwin's Dangerous Idea* (1995), p. 64.

[295] But Burdach, teacher of von Baer, still refered to the specialised meaning of the study of man. R. J. Richards, *Meaning of Evolution* (1992), pp. 17-18.

[296] See: T. Lenoir, *Morphotypes in Romantic Biology* (1990), p. 119.

[297] T. G. A. Roose, *Grundzüge der Lehre von der Lebenskraft* (1797/1800). K. F. Burdach, *Propädeutik zum Studium der gesammten Heilkunst* (1800), p. 62. G. R. Treviranus, *Biologie oder Philosophie der belebten Natur* (1802), Volume 1, p. 2. J. B. Lamarck, *Recherches sur l'organisation des corps vivans*. Paris (1802), p. 202. Quoted in D. v. Engelhardt, *Wissenschaft und Philosophie der Natur um 1800* (1994), p. 260.

[298] J. C. Greene in *The Kuhnian Paradigm and the Darwinian Revolution in Natural History* (1971/1981) distinguishes three similar types of theories, pp. 38-46.

(3) *Romantic* (and German Idealist) *Biology*, with the concept of the unfolding of nature (evolution in the literal sense). This concept combines an emphasis on structure and on development of nature.

After a section on Linnaeus these groups will be described successively (section b, c and d). In conclusion I will once again give a comparative overview to justify this classification.

a) Hierarchical Taxonomy instead of 'Scala Naturae' – Linnaeus

Carl Linnaeus (1707-1778), also called Carl von Linné, is often regarded as the 'father' of modern biological taxonomy. Of course there were also 'grandparents' in the early modern era, who could not be treated here.[299]

Linnaeus worked on all three classical kingdoms of nature, vegetable, animal and mineral. His hierarchical taxonomic 'tree' (each entity is only part of one higher entity) had five levels: class, order, genus, species and variety. Since *Philosophia botanica* (1751) Linnaeus gave organisms generally two-word names, denoting their genus and species. He overcame the habit of longer and transient phrase-names, which themselves gave a short description and contrasted the animal with other animals[300]. Certainly, he did not always display a 'natural' order, but at least he founded a stable, communicable and internationally accepted system of classification, which became a common basis for modern biology.

Linnaeus' system was by no means created *ex nihilo*. He adopted parts of his structure and many names from Aristotle. For example, the names of the classes in which he divided the animal kingdom (*Aves*, *Amphibia*, *Pisces*, *Insecta*, *Vermes* and *Quadrupedia*) are derived from the Latin translations of terms used already by Aristotle. Linnaeus himself only coined the class label '*Mammalia*', replacing the Aristotelian term '*Quadrupedia*' in later editions of his *Systema Naturae*.[301]

In his first and canonical 10th edition (1735/1758) of his *Systema naturae* he classified men very closely to monkeys. In the first edition he lumped men together with them under the *Anthropomorphia* division of the *Quadrupedia* and later he put *Homo sapiens* together with *Homo troglodytes* (orang-utan) under the genus *Homo*.[302]

It is obvious that such a mere classification is not free of any implicit theory. The way Linnaeus described and ordered nature has many theoretical and even socio-political[303] aspects. Linnaeus believed in the rational order of God's creation, in the fixity of species (in his later days at least in the fixity of major groups) and because of

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[299] I have to skip naturalists and taxonomists like Hieronymus Bock (1489-1554), Andrea Cesalpino (1519-1603), John Ray (1627-1705), Joseph Pitton de Tournefort (1656-1708) because the work of Linnaeus was most influential. See: E. Mayr, *Growth of Biological Thought* (1982).

[300] L. Koerner, *Carl Linnaeus in His Time and Place* (1996), p. 149.

[301] L. Schiebinger, *Mammals, Primatology and Sexology* (1994), pp. 185 f.
But Cuvier still used the term "quadrupeds" in his great 'fossils' volumes of 1812.

[302] D. Knight, *Ordering the World* (1981), pp. 57, 79-80.

[303] L. Schiebinger shows how the patriarchal view of Linnaeus is parly fossilised in the present taxonomy: *Mammals, Primatology and Sexology* (1994); *Gender and natural history* (1996).

this in the possibility of an adequate taxonomy of clearly distinguished taxons. On the other hand, this taxonomy could also be seen as a preparation for the overcoming of the idea of a linear order of a *scala naturae*: his hierarchical tree-formed taxonomy is the basis for the scientific conception of phylogenesis as a branching process with a common descent, stated by transformists like Geoffroy St. Hilaire and later on by Darwin.

b) Romanticising Materialistic Biology – Buffon, Lamarck

I call this school – in an apparent contradiction in terms – *'Romanticising' Materialistic Biology*, because the father of this school, Buffon, who could be regarded as the first modern 'biologist' who proposed evolutionism, is not only commonly regarded as a materialist, but had also been strongly influenced by Spinoza, a favourite of the German Romantic philosophers.

Gorges-Louis Leclerc Comte de Buffon (1707-1988) was the first influential modern naturalist who speculated about the transformation of species. He not only very early introduced some philosophical concepts to biology, but he also gave an example of great scholarly work, especially with his main work *Histoire naturelle* (1749-1789), which when completed, consisted of 36 volumes.

Buffon disputed Linnaeus' system[304]and focused himself not so much on the abstract and fixed definition of animals, but studied living animals in their natural surroundings, focusing on geographical differences.[305] He defined species in terms of the possibility of interbreeding rather than morphology.[306] He realised differences of species in different ecosystems which led him to speculations about why these differences arise: species can, according to him, to a certain extent adapt to their environment, but they could also degenerate and become extinct. At first, he believed that all of today's species derived from 40 prototypical species, while the late Buffon even played with the idea of common descent. [307] When Buffon in 1749 proclaimed his theory of the formation of the earth, he called forth a strong critical response, particularly on religious grounds. But in 1778, when he published *Les époches de la nature* (*The Epochs of Nature*), a supplementary volume to his *Histoire naturelle*, he was only perfunctorily criticised for his claim that human history is only the last of seven epochs of the development of nature.[308]

Buffon's philosophical background is – as mentioned earlier – not sufficiently described by simply calling him a materialist. It is indeed true that he dismissed the doctrine of final causes: "Those who believe they can answer these questions by final causes do not perceive that they take the effect for the cause"[309]. But unlike Denis

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[304] C. J. Greene, *Kuhnian Paradigm and the Darwinian Revolution in Natural History* (1971/1981), pp. 34-37.

[305] D. Young, *Discovery of Evolution* (1992), p. 61.

[306] D. Knight, *Ordering the World* (1981), p. 79.

[307] A. Wolf, *Buffon's Philosophy.* In: *History of Science, Technology, and Philosophy*, pp. 792-793.

[308] D. v. Engelhardt, *Historical Consciousness in the German Romantic Naturforschung* (1990), p. 64.

[308] Mentioned in: M. Rudwick, *Minerals, Strata and Fossils* (1996), p. 285.

[309] G. D. Buffon, *History of Animals*, quoted in J. Barrow, F. Tipler, *Design Arguments in Anthropic Cosmological Principle* (1990/1986), p. 68.

Diderot (1713-1784) and Paul Baron d'Holbach (1723-1789), his ultimate constituents of Nature were *living* and *active*. Although Buffon used a deistic language, he had a pantheistic philosophy, originating in Spinoza's '*deus sive natura*' (God or Nature). Even more explicitly Jean Baltiste Robinet (1735-1820) presented a view of cosmic vitalism.[310]

Jean-Baptiste de Lamarck (1744-1829) stated his explicit theory of evolution at the *Muséum National d'Histoire Naturelle* (National Museum of Natural History) in Paris, which was founded during the French revolution with the commission to build up a rational biology "that would mirror the rationality of the new France and would distance it from the chaotic medievalism of the *ancien régime*"[311]

Lamarck was influenced by Buffon, whose son he tutored and who had, in pre-revolutionary times, been the administrator of the *Jardin du Roi*, which in 1793 was reorganised partially by Lamarck as the new museum.

Like Buffon, Lamarck was a convinced evolutionist. Lamarck thought of a time scheme of millions of years for earth history and continental changes. He was convinced of the transformation of animals as a consequence of his geological theory,[312] through his biological studies of the mollusc collection of the Paris Museum[313]. Corresponding to his optimistic revolutionary zeal he strongly believed in an 'upward' progression also in nature. Despite this and although later in history saltationist theories were subsumed under the term Lamarckism, Lamarck himself was, like Darwin, not an advocate of essentialism and was convinced of the gradualness of evolutionary change.[314] In this sense he has to be, along with Darwin, contrasted with the essentialism of transcendental and romantic biology.

In his early writings Lamarck assumed only one scale[315] of rising complexity. By this he (implicitly) took over the Christian idea of the Great Chain of Being and 'dynamised' it. Because of this unidirectional process, extinction does not play an important role in his system. Although the branching remained less central to him than later on to Darwin, from 1800 to 1815 he progressively replaced the picture of a linear upward progression by that of a branching tree.[316]

But to Lamarck the organisms were not objects but agents of this upward directed evolutionary process. Active individuals – like revolutionaries – "take their fate into their own hands".[317] First in his *Discours d'ouverture* (1800), then in his *Système des*

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[310] A. Wolf, *Buffon's Philosophy*. In: *History of Science, Technology, and Philosophy*, pp. 792-793.

[311] D. J. Depew, B. Weber, *Darwinism Evolving* (1995), p. 43.

[312] J. C. Greene, *Kuhnian Paradigm and the Darwinian Revolution in Natural History* (1971/1981), pp. 41, 43.

[313] See: E. Mayr, *Growth of Biological Thought* (1982), p. 346.

[314] *Ibid,* pp. 346, 355.

[315] J. B. Lamarck had to acknowledge that not all species could be arranged on one scale, he changed this extreme view, assuming this scale only for larger taxa. He also stated the branching of lines, but this has never been (as in Darwin's theory) *the* core part of his theory. In *Histoire Naturelle des Animaux sans Vertébrés* (1815) there are two main lines. Both especially the *articulés (vertebrata)* and *inarticulés,* both are branching. See: F. M. Wuketits, *Evolutionstheorien* (1995), p. 40.

[316] E. Mayr, *Growth of Biological Thought* (1982), p. 351.

[317] D. J. Depew, B. Weber, *Darwinism Evolving* (1995), p. 45.

animaux sans vertèbres (1801) and in his *Philosophie Zoologique* (1809) species "transformés en une espèce nouvelle, distincte de l'autre"[318]. Animals are able to face the change of the environment, by actively changing their behaviour, which in turn causes a change of their physical properties. In this sense new characters were not directly introduced by the environment, but produced as a response to the environment by the internal activities of the organism. Acquired properties are not lost in each generation, but they are inherited. [319]

Although Lamarck was a materialist to whom nature was mainly "a law-bound system of matter in motion"[320], who did not believe in essentialism or teleology, I think it is still correct and necessary to describe him also, like Buffon, with the adjective 'romanticising', because his materialism was not based on Newton's mechanical vision, but on the idea that matter has "self-creating powers and self-developing energies"[321].

c) Transcendental and Essentialist Biology – Cuvier, (early) Owen, Agassiz

The term 'Transcendental Philosophy' is normally applied to Kant and his followers. It also refers in general to a philosophy built on philosophical knowledge *a priori.*[322] Knowledge *a priori* is a necessary precondition to our understanding and is not empirically but in a logical sense true. 'Transcendental Biology' would consequently mean the basic biological knowledge derived from such concepts *a priori.*

Kant, especially to his *Critique of Teleological Judgement*, tried to give a unifying account of mechanistic and teleological principles. Apart from a certain rehabilitation of teleology as a regulative idea, he also formulated the (regulative) concept of a fundamental uniting ground plan of an organism.[323] Kant already at least considered the possibility of evolution with common descent.[324] Still Kant's main focus is on necessary structure (now in an aprioric sense), whereas biologists in the wrake of German idealism and then romanticism focused on the evolutionary unfolding of structure in time. Although structure is taken to unfold dynamically, it is, in this tradition, often taken to unfold with some structural necessary. Due to the relations between these schools of thought, the line between transcendental and romantic biology is blurred. Here transcendental biology, however, is grouped together with essentialist biology, due to its stress on necessary structure.

> *Romanticism* in the broad sense, particularly in the Anglophone world, has been used to cover biological accounts, including transcendental biologist as well as romantic biologists (➲ p. 82). Transcendental biologists and romantic biologists may be distinguished by referring either predominantly to Kant or to Schelling. But Schelling built his system of *Naturphilosophie* on some aspects of Kant's more rigorous transcendentalism, and some biologists also have changed their views along these lines. Moreover, although many

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[318] J. B. Lamarck, *Philosophie Zoologique* (1809), I, p. 261.

[319] See: E. Mayr, *Growth of Biological Thought* (1982), p. 357. D. v. Engelhardt, *Wissenschaft und Philosophie um 1800.* (1994), pp. 261-262.

[320] J. C. Greene, *Kuhnian Paradigm and the Darwinian Revolution in Natural History* (1971/1981), p. 42.

[321] D. J. Depew, B. Weber, *Darwinism Evolving* (1995), pp. 47-48.

[322] I. Kant, *Kritik der reinen Vernunft* (1781/1787), A, B, pp. 25, 150.

[323] I. Kant, *Kritik der Urteilskraft* (1790/1793/1799), pp. 289-298.

[324] *Ibid,* pp. 368 f.

> biologists of that time had a considerable knowledge of philosophy, they sometimes have drawn from Kant, Schelling or Goethe in a rather eclectic way.
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> Because the notions of transformation and morphology are crucial to early evolutionary theories, I separate these two approaches arbitrarily: romantic biology is here defined with reference to the notions of transformation and form, whereas transcendental biology here refers to an *a prioric* reinterpretation and elaboration of concepts like essentialism, form, and body plan.

Classical essentialist biology may also be mentioned under the heading of essentialism. As already outlined, Platonists, Aristotelians and scholastics have believed, actually in quite different ways, in the existence of an essence of entities. Normally the underlying, defining and indispensable 'core' of an entity is meant. These more directly ontological currents and the later essentialism of the French biologist Cuvier are here lumped together with transcendental biology, more based on epistemology. Despite differences in their foundations, all have advocated *unity of plan* and often (at least in the limited sense of a regulative idea) made use of the concept of teleology.

In biology we come across terms like *transcendental morphology* or *anatomy*, which can refer to both a biological discipline and a school which focuses on a unifying plan of the parts of an organism.[325] Proponents have been influenced by Kantianism or by classical essentialist schools.

Biologists like *Caspar Friedrich Wolff* (1734-94) and *Johann Friedrich Blumenbach* (1752-1840) emphasised the historical-genetic method as biological methodology and that biological phenomena such as "ontogenesis, growth and reproduction could not be reduced purely and simply to physico-mechanical forces."[326] Recently also this role of Karl Friedrich Kielmeyer (1765-1844) had been stressed.[327]. By their account these *Naturforscher* hoped – like Kant – to "chart a course between the Scylla of reductionistic mechanism and the Charybdis of vitalism".[328]

> Blumbach and Kielmeyer also influenced Schelling and have also adopted some transformationalist approach.[329] Hence, it might have also been reasonable to class them as romantic Biologists. They provide good examples how difficult a distinction between transcendental and romantic biology is. Blumbach has even coined the notion '*Bildungstrieb*', crucial for romantic biology.

The most important biologist focusing on the unity of type argument was *Georges Cuvier* (1769-1832). He gained influence in the time of the Napoleonic Empire and also in postrevolutionary France after the defeat of Napoleon. Like Lamarck and Geoffroy St. Hilaire he worked at the *Muséum National d'Histoire Naturelle.* Probably he was more influenced by (the medieval conception of) Aristotle than by Kant, because

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[325] Ph. Rehbock, *Transcendental Anatomy* (1990).

[326] W. Lefevre, *Die Entstehung der biologischen Evolutionstheorie* (1984), pp. 26-68. Referred to in: T. Lenoir, *Morphotypes in Romantic Biology* (1990), pp. 119-120.

[327] K. T. Kranz (Ed.), *Philosophie des Organischen in der Goethezeit: Studien zu Werk und Wirkung des Naturforschers Carl Friedrich Kielmeyer* (1994). Th. Bach, *Kielmeyer als 'Vater der Naturphilosophie'?* (1994); B*iologie und Philosophie bei C. F. Kielmeyer und F. W. J. Schelling* (2001). ➲ footnote 331.

[328] T. Lenoir, *Morphotypes in Romantic Biology* (1990), p. 120.

[329] R. J. Richards, *Meaning of Evolution* (1992), pp. 25-29. D. v. Engelhardt, *Wissenschaft und Philosophie um 1800.* (1994), p. 262.

it seems that teleology was more to him than only a regulative idea. Cuvier had spent his youth at the Karlsschule in Stuttgart where he had "been steeped in essentialism".[330] There he was a fellow student of and tutored by Kielmeyer, who – methodologically influenced by Kant – turned against an exclusive mechanistic account of nature.[331]

Influentially Cuvier advocated the concept of body plans: In his great work *Le règne animal*[332] (1817) he reduced the basic types of Aristotle and distinguished only four basic body plans or *embranchements*: *radiata* (e. g., jellyfish and starfish)*, articulata* (e. g., bees and lobsters)*, mollusca* (e. g., clams and octopuses) and *vertebrata* (e. g., fish and men). By this he focused not on the 'vertical' linear series of evolution[333], like Lamarckism did, but on 'horizontal' unbridgeable differences between taxa, say between the exoskeleton of articulata and the inner skeleton of the vertebrata.

He stated the so-called 'principle of correlation': the parts are coadapted to the whole of the organism. This corresponds to Aristotle's idea of the principle unifying the parts of an organism (soul) or Kant's regulative idea of 'the whole structuring the part'. Because to Cuvier there is no part of an organism which can independently change on its own and because of the huge differences of the *embranchements* he, like Linnaeus, was normally considered an advocate of the concept of fixity.

But even Cuvier adopted the concept that *within* the *embranchements* species could accommodate their particular structure.[334] Himself famous for his research on fossils, Cuvier had to face the empirical fact that not all fossils, which he found around Paris, corresponded to living species. As also the theory of migration did not seem to explain the problem, he saved the hard-core of his indeed rather static paradigm by adopting geological catastrophism. He believed (like Buffon) that species could become extinct. To him there are whole series of extinct faunas, especially caused by geological catastrophes.[335] Because there had been also newer fossils which could not be found in older strata, he also assumed that "new species, based on existing body plans, are inserted by God into a vacated ecological slot".[336]

In any case, Cuvier was regarded rather as a strong advocate of the concept of fixed form, in Mayr's terms 'essentialism', than of transformation.

> Because of his rather static world-view, Cuvier has sometimes been associated with reactionary politics opposing in the field of biology the radical, democratic ideas of the French Revolution of his opponents Lamarck and Geoffroy St. Hilaire.

Richard Owen (1804-1892) is often regarded as 'the British Cuvier'. He was as influential in Britain as Cuvier was in France, especially with his main works *On the*

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[330] E. Mayr, *Growth of Biological Thought* (1982), p. 364.

[331] R. J. Richards, *Meaning of Evolution* (1992), pp. 18-19. D. v. Engelhardt, *Wissenschaft und Philosophie um 1800.* (1994), pp. 255, 260, 262. ➲ footnote 327.

[332] French for: *The Animal Kingdom.*

[333] Before 1800 Cuvier was similar to Lamarck in being convinced of a linear evolution.

[334] R. J. Richards, *The Meaning of Evolution* (1992), pp. 51-52.

[335] See: J. C. Greene, *Kuhnian Paradigm and the Darwinian Revolution in Natural History* (1971/1981), p. 39.

[336] D. J. Depew, B. Weber, *Darwinism Evolving* (1995), p. 45.

Archetype and Homologies of the Vertebrate Skeleton (1848) and *On the Nature of Limbs* (1849). He took over the methodology of comparative anatomy and the concept of body plans. Like Cuvier he also was engaged in a dispute against the (mainly materialistic) theory of evolution.

Robert Edmond Grant and Robert Knox brought mainly Lamarck's materialistic, but also Geoffroy's and Oken's romantic ideas, to Edinburgh. The emerging conflict of Owen versus Grant and Robert Knox in the 1830s mirrors the conflict between Cuvier versus Lamarck and Geoffroy St. Hilaire. The result of the conflict was also similar. Owen, at that time a non-transformational essentialist, at the end of the conflict gained dominance over the romanticising materialist Grant.

But from the 1840s Owen himself became strongly influenced by later rather evolutionary romantic currents of German *Naturphilosophie*. Because of this we might not only call him 'the British Cuvier', but also – later in his life – 'the British Geoffroy', [337] and because of this we will treat him once more in the next section on romantic biology.[338]

Louis Rodolphe Agassiz (1807-1873), called 'the American Cuvier', was a Swiss-born palaeontologist and *the* founder of academic biology in the United States. Although he was influenced by Oken's *Naturphilosophie,* while studying with him at Munich, he advocated the fixity of species. Hence he is not treated here in the section 'romantic biology', but we deal with him here directly after Cuvier.

To Agassiz, opposite to today's biology, only genera and all higher taxa have real existence. The forms of higher taxa outlive the individual and they are like Platonic forms – more real than the individuals that exemplify them. Like Cuvier he believed that species could become extinct and are separately 'created'.[339] Also like Cuvier he focused on a 'horizontal' aspect. Agassiz not only saw the differences of body plans of different species, which could not be ordered in *one* linear *Scala naturae*, but he also focused on different – we would now say – 'ecological systems'. To Agassiz each zoological region is separately created.[340]

d) Romantic Biology – Oken, Geoffroy Saint-Hilaire, (late) Owen

In response especially to Schelling (➲ pp. 82 f.) objective idealism and romanticism also gained an early influence in biology. Later on, at the end of the 19th century, when there was an eclipse of Darwinism, similar ideas had their second heyday in biology, corresponding to a world wide revival of idealism in philosophy (➲ pp. 121 f., 187 f.). Here we are concerned with pre-Darwinian approaches.

In *Lorenz Oken*'s (1779-1851) book '*Lehrbuch der Naturphilosophie*' (1809-11) *Naturphilosophie* is to him – as to Schelling – a historical as well as a structural enterprise. Man and Nature have both one *Entwicklungsgeschichte,* with its highest manifestation in

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[337] Ph. Rehbock, *Transcendental Anatomy* (1990), p. 153.

[338] N. Rupke, *Richard Owen* (1994, 2009) provides a more comple account of R. Owen's biography.

[339] I could not judge here, whether the notion 'creation' to Agassiz might mean something similar as 'unfolding of nature' means to the romantics. If this were the case then I would have to treat Agassiz in the class of romantic biology.

[340] D. Knight, *Ordering the World* (1981), pp. 113 f.

the human being. But for the process of unfolding, the aspect of form or structure is central. Even more, differing from the Linnaean-Cuvierian tradition, structure is dictating function, not function form.[341] Many scholars emphasise that Oken 'only' believed in an *ideal* transformation, not in *actual* transformation;[342] whereas other authors seem to have different opinions.[343] Anyway, in the tradition of Oken "it became the custom to look upon the different forms of animals as developed out of one another"[344]

Johann Wolfgang von Goethe, poet and naturalist, was influenced by Spinoza, Schelling and even by Erasmus Darwin[345], Charles Darwin's grandfather. In *Versuch die Metamorphose der Pflanzen zu erklären* (1790) Goethe argues that the organs of plants, though seemingly dissimilar, could be understood as transformations of one underlying structure – that of the ideal leaf. He advocated the Blumbachian *Bildungstrieb*, an inherent drive to perfection, although he also accepted the importance of external conditions to evolution, on which Darwin would later on rest his theory. Goethe believed that repetition and transformation are crucial aspects of evolution. Goethe, like Oken, proposed a vertebral theory of the skull, meaning that the skull is composed out of transformed vertebrae. His search for a common archetype, basic to all organisms, led to his discovery of the human intermaxillary bone.

Romantic biologists, like Oken, Carl Gustav Carus (1789-1869) or Geoffroy St. Hilaire, are characterised by the focus on the unity of the morphology of an organism, on a common archetype, on necessary serial development, on an inner tendency to progress[346], on parallelism of ontogenesis and phylogenesis, on (ideal) transformation, and on the phenomenon of homology, which shows that certain ideal types of forms are reached in different lines of evolution.

> The theory of recapitulation became very important for the notion of evolution, linking the notion of individual (embryological) and species development (or even ecological development). In early versions the theory of embryological recapitulation referred to stages of now-existing species, in the later to stages of now-extinct species.[347]

Étienne Geoffroy St. Hilaire (1772-1844), who could be referred to as 'the French Oken', was influenced via Oken and Carus by Schelling. Organisms are not only *natura*

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[341] J. C. Greene, *Kuhnian Paradigm and the Darwinian Revolution in Natural History* (1971/1981), p. 44.

[342] See E. Richard, *The Romantic Gestation of Nature* (1990), p. 133. R. J. Richards, *The Meaning of Evolution* (1992), p. 42. D. J. Depew, B. Weber, *Darwinism Evolving* (1995), p. 49.

[343] According to the German philosopher R. Löw, Oken defines zoology as 'science of the development of species of animals' (transl.), but regards transmutation of species as an insight *a priori*, see *Die Entstehung des Neuen in der Natur* (1984), p. 55. The interpretations of Oken may refer to the different importance attributed to knowledge *a priori*.

[344] K. E. v. Baer, *Über Entwicklungsgeschichte der Thiere* (1928), pp. 129-201 (translation by T. H. Huxley), quoted in E. Richards, *The Romantic Gestation of Nature* (1990), p. 132.

[345] D. King-Hele, *Erasmus Darwin and the Romantic Poets* (1986), pp. 169-171.

[346] Progress based on *internal* tendencies may have to be distinguished from progress towards an *externally* given teleological goal. Goethe, for instance, seems to have advocated the former, but not the latter position. See: St. J. Gould, *The Structure of Evolutionary Theory* (2005), p. 288 f.

[347] This aspect is exellently treated in R. J. Richards, *The Meaning of Evolution* (1992).

naturata like in Platonism, but to him also *natura naturans*.[348] He was clearly convinced of *actual* transformation. Still he believed like his German predecessors in an inner logic of development, in the explanatory force of concepts like serial development, parallelism and homology. To him the structures of the parts of an organism have to correspond with the whole in a necessary way (*unité de plan*). In this respect he is in accordance with Cuvier, whom he worked with for a long time. Still, Geoffroy abandoned teleology and even also introduced concepts of elimination and adaptation[349]. In 1820, still following the research programme of uniting body plans, he found parallels which united the *mollusca* and *radiata*, and the *articulata* and *vertebrata.* In 1830 he even proclaimed the unity of the whole animal kingdom. This transformational unification of the *embranchements* brought Geoffroy into conflict with Cuvier's fixism.[350]

Geoffroy's alignment with Lamarck in the Cuvier versus Lamarck debate is due to their common belief in transformation. But because of their co-operation, conceptual differences between them have often been ignored. Geoffroy did not believe in *one* 'ladder of nature' where every species has to climb up from the bottom, but in common descent. Moreover his explanation of evolution was mainly structural along idealist/romantic lines rather than being mechanistic, so that Goethe even in his last works still tried to support him.

After the death of Lamarck in 1829, Cuvier managed, because of his reputation and some reasonable points in the debate, to finish the dispute in his own favour. On the solemn occasion of Lamarck's funeral, Cuvier, according to the tradition of the academy, gave a memorial lecture. He presented this lecture in the way that it seemed that he buried not only Lamarck, but also Lamarck's and Geoffroy's theories. Cuvier's ideas dominated French biology after Cuvier's death in 1832 till about 1850.

Since the 1840s *Owen* (➲ also p. 94) was increasingly impressed by the Romantics and even by their concept of an immanent divine unfolding of nature, although he had before vigorously attacked Grant's rather materialist Lamarckian evolutionary approach.

In his conceptual change, Owen was especially influenced by Joseph Henry Green (1791-1863), who himself studied under Oken and was affected by the thought of the romantic poet and philosopher Samuel Taylor Coleridge (1772-1834). Green seemed to have come to the belief that the old argument from design must be "replaced with a new argument based on divine self-expression"; hence the origin of species was to him, as to the German romantic idealists "the creative self-externalisation of a divine mind immanent in nature, rather than as a collection of highly rigid, if well-adapted, machines produced by a quaint eighteenth-century Deist designer."[351] Green already argued that Evolution was not linear but treelike[352]. Coleridge played an important

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[348] D. J. Depew and B. Weber in their usually very scholarly book *Darwinism Evolving* (1995) designate this current as 'neomedievalizing obscurantism of Naturphilosophie', which might be a bit one-sided, p. 55.

[349] E. Mayr, *Growth of Biological Thought* (1982), p. 363.

[350] R. J. Richards, *The Meaning of Evolution* (1992), p. 52.

[351] D. J. Depew, B. Weber, *Darwinism Evolving* (1995), p. 55.

[352] R. J. Richards, *The Meaning of Evolution* (1992), pp. 74, 77.

role in introducing the thoughts of Kant and the idealists to a larger public, particularly since translations did not begin to appear well into the 1830s. His mainly poetic approach did much for the accessibility of these thoughts, but in England gave them a reputation of flights into vague spiritual realms.[353]

Although the *young* Owen, the 'British Cuvier', had led the campaign against some materialist evolutionists, the *later* Owen, the 'British Geoffroy' came to believe in a romantic concept of transformation. In his *On the Nature of Limbs* (1849) he considers the possibility of an actual unfolding of the divine creation and although in the 1850s he was guarded enough to largely evade mentioning this issue in print, he still made suggestions about the branching process of natural development[354].

> Owen's biography might force us to distinguish even more periods of his intellectual development. After reading von Baer's critique of the principle of recapitulation, Owen dismissed this central romantic principle.[355]

Despite Owen´s positive attitude towards evolution in general he opposed the mechanistic Darwinian account of evolution. There was for example a clash between Owen and T. H. Huxley, Darwin's bulldog, at the meeting, where the famous anecdote of a clash between Huxley and Bishop Samuel Wilberforce (1805-73) took place.[356] That Owen really believed in actual evolution, apart from his dislike of Darwin's *Origin,* is supported by his welcome to Robert Chambers' (1802-71) *Vestiges* in 1844, which had popularised romantic evolutionism in England.[357]

e) Conclusion: Overview of the Preceding Three Schools

In Table 2 a more formalised (and thereby, perhaps, a more simplified) overview of the different characteristics of the previously described schools is given. The two middle columns of the table justify the distinction that there are three groups of partly concurrent biological theories.

Despite possible doubts about details of such a classification and although it is transparent that the actual positions of the mentioned philosophers or scientist will actually differ in many more respects, this simple classification of pre-Darwinian theories of nature in (at least) three types highlights important aspects of any discussion on Darwinism. Moreover, this simple classification is at least more helpful than dichotomous classifications that are often employed, at least implicitly. In the previously mentioned conflicts of Linnaeus versus Buffon, or of Cuvier versus Lamarck and Geoffroy St. Hilaire, or of the early Owen versus Knox and Grant there normally seem to be only *two* camps: the biologists, who believed in the fixity of species (see Table 3: ❷) versus the biologists who believed in the transformation of

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[353] S. M. d. Otter, *British Idealism and Social Explanation* (1996)*,* p. 22.

[354] E.g., P. Bowler, *Charles Darwin* (1990), pp. 25, 30-31.

[355] See: R. J. Richards, *The Meaning of Evolution* (1992).

[356] D. Knight, *Ordering the World* (1981), pp. 170 f. R. J. Richards, *Darwin and the Emergence of Evolutionary Theories of Mind and Behavior* (1987), pp. 549-551.

[357] *Ibid,* p. 168. On the popularity of the vestiges: J. Secord, *Introduction to Chamber's Vestiges* (1994), pp. ix f., xxvi f.

species (❶ and ❸). In such treatments of these dispute the difference within the transformationalist camp between Oken and Geoffroy St. Hilaire on the one side and the Lamarckians on the other side is overshadowed by their alliance against the dominant third Cuvierian group emphasising the fixity of species.

	Vertical aspect (mainly: transformion vs. fixation)	Horizontal aspect[358] (mainly: definition of species and form vs. function[359])	Annotations
Plato	fixation	eternal form (*eidos*)	in the medieval interpretation the form is an idea of God
Aristotle	fixation[360]	form (*eidos*)	*causa finalis*, *causa efficiens* (also *materialis* and *formalis*)
Linnaeus	fixation (later: *some* transformation)	morphology (and inter-breeding[361])	
❶ Buffon	transformation (limited), degeneration	interbreeding[362]	influenced by Newton, Spinoza, but mainly *c. efficiens*, multiple descent (later: common decent)
❶ Lamarck	transformation, upward development	no species[363], groups (masses), function	no common descent, minor role of extinction, gradual upward evolution, active adjustment
(❶) Grant	transformation		largely Lamarckian, partly Geoffroyian gradual upward development, unity of form
❷ Cuvier	fixity (also extinction, special creation)	morphology (function[359])	catastrophism, new species in old forms, teleology (Aristotle)
❷ Owen (early)	fixity (extinction, special creation)	morphology (function)	(no teleology)[364]
❷ Agassiz	fixity (also extinction, special creation)	morphology (function)	separate creation of whole zoological regions; teleology
❸ Schelling	transformation (ideal)	form (*eidos*)	deus sive natura; differentiation of Oneness, development towards self-consciousness
❸ Oken	transformation (ideal)	morphology (form[359])	deus sive natura; development of nature towards self-consciousness
❸ Geoffroy Saint-Hilaire	transformation (actual)	morphology (form)	common descent, deus sive natura, development of nature towards self-consciousness

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[358] See annotations of Table 4.

[359] St. J. Gould, *The Structure of Evolutionary Theory* (2005), e.g., pp. 64 f., 159, 283, 289, 313, 329 f.

[360] But see: R. J. Richards, *The Meaning of Evolution* (1992), p. 63.

[361] D. Young, *Discovery of Evolution* (1992), pp. 55-56, 61.

[362] *Ibid,* p. 63.

[363] E. Mayr, *One Long Argument* (1991), p. 17.

[364] Darwin mentioned that Owen (in *Nature of the Limbs*) took a critical stance towards the concept of teleology. C. Darwin, *Origin* (1859), p. 416.

❸ Green	transformation	morphology (form)	common descent, development of nature towards man
❸ Chambers	transformation	morphology (form)	popular science; development of nature towards man
❸ Owen (late)	transformation	morphology (form[7])	development of nature towards man
Paley	creationism, fixity	function	mechanistic approach
Darwin (after 1838)	transformation (upward and downward)	Interbreeding, (function[359])	*causa efficiens*; gradualism; common descent; natural selection

Table 2: Simplified overview of some of the important biologists and naturalists from around 1800 to the time before Darwin's *Origin* (1859). The numbers refer to what can be regarded as the three main types of fundamental biological theories: ❶ (Romanticising) materialistic biology, ❷ essentialist and transcendental biology, ❸ romantic biology. The column headings 'vertical' and 'horizontal aspects' are referring to our *today's* picture of an evolutionary 'tree'. The vertical dimension is concerned with change of lineage throughout time. The horizontal aspect is concerned with differences at one time and their explanation. (Also ➲ the sections b, c and d of this chapter.)

Another dichotomic simplification lumps all biologists focusing on form, i. e. both transcendental biologists and romantic biologists advocating idealist evolution into one big group (❷ and ❸). This combination indeed mirrors the historical connection between Kant and the German idealists. The relation to a traditional essentialist view is that necessary ideas/forms and even notions like teleology became reintroduced on the basis of Kant's 'subjective' turn. Likewise, Geoffroy for example was influenced by Oken (❸) but worked also a long time together with Cuvier (❷), who himself studied in Germany. Owen, the British Cuvier, a prototypic proponent of (transcendental) fixity of species (❷), later also took a rather dynamic stance (❸). Hence the distinction between these two groups becomes blurred.

Also for the debates today, it is of interest that not only Darwinism postulated a transformation of species and that not only theories of fixism advocated an importance of form (cf. Table 3).

In the next chapters an account of the development of Darwinism will be given. Darwinism in Britain had already gained influence in the 1860s, although evolutionists like Owen and Knox turned against this type of explanation of evolution,[365] and although Victorian 'Darwinism' differed considerably both from Darwin's theory and modern Darwinism[366]. Chapter 4 will focus on the *internal* history of the development of Darwinism, introducing three main sub-paradigms of its theoretical development. Discussion of which currents Darwinism and its sub-paradigms have been influenced by will be addressed in Chapter 5, on the *external* history of Darwinism.

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[365] Ph. F. Rehbock, *Philosophical Naturalists: Themes in Early Nineteenth-Century British Biology* (1983), pp. 192, 195.

[366] P. Bowler, ➲ footnote 404.

	no evolution	evolution
no importance of form		❶ (Romanticising) materialistic biology
importance of form	❷ essentialist and (early) transcendental biology	❸ romantic biology

Table 3: The three types of pre-Darwinian Biology. But please note: Certainly, ❸ is not the logical conjunction of ❶ ∧ ❷. The notion of evolution in ❶ is mechanical and in ❸ it refers to an 'organismic' unfolding of nature. Moreover the notion 'morphology' in ❷ focused on function, in ❸ on structure; and in ❷ we may today regard form or morphology as an indicator of a 'horizontal aspect', whereas in ❸ form – thinking of the parallels of zoology and embryology – is not necessarily linked to a horizontal aspect.

Chapter 4: The Internal Logic of Evolutionary Theories – From Darwin to Dawkins

In this chapter on the *internal* history of evolutionary theories, the main claim is that there have been structurally different subparadigms within the main Darwinian framework. Only in Chapter 5, when dealing with an *external* history of these subparadigms (➲ pp. 160), will it for example be discussed how Darwin had come to his theoretical synthesis out of Newtonian and Romantic thought and how this synthesis was influenced by theories of Malthus and by the economic situation in Britain. Here, the main differences of these sub-paradigms will be investigated.

If we want to trace the subparadigms of a Darwinian research tradition through history one has to make clear what is meant by the term 'Darwinism'. The way we *define* 'Darwinism' is crucial, because it determines, what and who is to be regarded as Darwinian. Even several aspects of Darwin's own theory, the theory of acquired characters (which he took over from Lamarck) and his theory of pangenesis would today certainly not be regarded as an example of Darwinism (➲ pp. 106). Hence, we need at least a working definition of Darwinism to exclude such notions.[367] E. Mayr describes a whole range of meanings of the term 'Darwinism':[368] Darwinism is seen as 'Darwin's theory of evolution', as evolutionism, as anti-creationism, anti-ideology, as selectionism, as variational evolution, as creed of the 'Darwinians', as new world-view[369] and as a new methodology.

At least for use in an internal history of Darwinism I think, in accordance with authors like E. Mayr and others[370], that it is reasonable to regard evolution by natural selection as the conceptual core of the Darwinian research tradition. During the further course of the work it will become clear that this notion is central to Darwinism and contrasts best with other views of evolution. However, if we give so much importance to natural selection this notion needs further specification.[367] Normally the term 'natural selection' has a double meaning which is clarified by regarding natural selection (in its broad sense) as a two step process[371] (or as a two step

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[367] Later on we will define Darwinism in an even stricter way, ➲ pp. 153, 358 f.

[368] E. Mayr, *One Long Argument* (1991), pp. 90-106. In *Darwin's Five Theories of Evolution* (1985) and in *Weismann and Evolution* (1985), pp. 297-305, Mayr gave a list more confined to the biological meanings of the term 'Darwinism': (1) again evolution as such, (2) theory of common descent, (3) multiplication of species, (4) gradualism, (5) natural selection.

[369] For example J. C. Greene defines 'Darwinism' more generally as the world view that seems to have been arrived at more or less independently by Spencer, Darwin, Huxley, and Wallace. J. C. Greene, *Darwinism As a World View,* in: *Science, Ideology and World View* (1981), pp. 128-130.

[370] E. Mayr, *One Long Argument* (1991), pp. 68, 107; *Darwin, Intellectual Revolutionary* (1983), p. 33; *Growth of Biological Thought* (1982), p. 510. Also D. J. Depew, B. Weber, *Darwinism Evolving* (1995), p. 2.

[371] E. Mayr, *Diversity of Life* (1978/1979), p. 19; *Darwin, Intellectual Revolutionary* (1983), p. 34; *One Long Argument* (1991), p. 68.

algorithm[372]). This two step process consists (a) of a blind chance process[373] of overproduction of varying entities, and (b) of natural selection in the narrow sense, the differential elimination of these varying entities (according to their degree of fit to a given environment). Following these basic theoretical principles the scarcity of resources follows and the 'struggle for life' will be severe. This process, which is an "opportunistic response to the moment"[374], should lead to an evolution by common descent and to the 'survival of the fittest'.

If Darwinism is understood as the above two step process, it is also easily contrasted to other historical concepts of evolution which have advocated a less wasteful and more directed evolutionary mechanism. In this work I mainly give an account of the *Darwinian* sub-paradigms. By doing this I mostly neglect the parallel development of a *Lamarckian* or *romantic* evolutionary research traditions.

> For several reasons a closer scrutiny of these currents would also be important: These schools of thought are not simply replaced by the 'Darwinian Revolution', but they also form a research tradition which still exists and which has interacted with and sometimes challenged the Darwinian tradition. It may be even difficult to disentangle the traditions:
>
> Some Darwinians might be not as thorough Darwinians as they suppose themselves to be, using e. g. the notion of body plans. Romantic and romanticising materialist biology seems even to have played a role already in the formation of Darwin's quite different theory (➲ pp. 163 f.). P. J. Bowler has pointed out that it is a historical myth, created by modern Darwinists, to assume that with the 'Darwinian Revolution' a pure version of Darwinism already became predominant in the late nineteenth century.[375] At the end of the 19th century, Darwinism was even supposed to be on its deathbed (➲ pp. 121 f.). The succeeding so called 'evolutionary synthesis' also draws largely from non-Darwinian Mendelian sources. Even gene-Darwinism which seems to be the most thorough version of Darwinism paradoxically may in some regards be influenced by romantic aspirations. Moreover, despite the empirical and theoretical defeat of romantic biology by the accepted evolutionary synthesis (➲ pp. 134 f.), parallel to the hardening of the synthesis a little new bloom could be observed. Not only radical advocates of a morphological account should be counted to this tradition, but – to be historically fair – partly also those, who emphasise inner constraints and direction (➲ pp. 144 f.).
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> Later on in the light of a strict definition of Darwinism one may disentangle the Darwinian and Non-Darwinian aspects present in many partly syncretic 'Darwinian' subparadigms.

If we regard natural selection as the unifying core of Darwinism, it becomes clear that Darwinians have differed (and still do differ) considerably in many respects. Darwin's writings and what is to be taken as Darwinism has been recepted in different ways even within Europe, with different implications for our self-understanding as human beings.[376] But even if one focuses on the dominant line of reception, Table 4 provides a first impression that Darwinism has been far from being monolithic.

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[372] D. Dennett, *Darwin's Dangerous Idea* (1995), pp. 48-60.

[373] J. Monod, E. Mayr, K. R. Popper, R. Dawkins, D. Dennett, ➲ footnote 1173.

[374] E. Mayr, *One Long Argument* (1991), p. 44.

[375] P. Bowler, *The Non-Darwinian Revolution* (1988); *Darwin* (1990), particular Chapter 1, 4, 9.

[376] E.-M. Engels, Th. F. Glick (Eds.), *The Reception of Charles Darwin in Europe* (2008).

	Mechanism of evolution	Object (or subject) of evolution	Definition of that entity	Focus of the theory	Application on humans?
Ch. Darwin (till 1837)	creation	— (fixity of species)	typological concept	—	—
Ch. Darwin (*Origin of Species*)	natural selection, inheritance of acquired characters	struggle between individuals	species: nominalistic, 'biological', then partly typological	strong belief in adaptionism on the level of the individual	not explicitly
Ch. Darwin (*Descent of Man*)	natural & sexual selection, acquired characters, correl. of parts	struggle between individuals and groups	(see above)	less extreme adaptionism	yes (with ambivalence)
A. R. Wallace	natural selection. (later: add. Mechanisms)	(individuals of) similar groups			yes, in the beginning, later not
T. H. Huxley	selection[377], saltationism	many biotic levels			yes, in the beginning, later not
A. Weismann (middle period)	natural selection, extreme gradualism	whole genotype		*Keimplasma* → *Somatoplasma*	
R. Fisher	natural selection (gradualism)	genes in gene pools	'biological' concept of species	population genetics, no gene interaction	yes: eugenics
J. B. Haldane	natural selection	genes in gene pools	'biological' concept of species	population genetics	
S. Wright	natural selection, genetic drift, etc.	group/deme-level, gene, individual[378]	'biological' concept of species	pop. genetics; shifting balance; gene interaction	

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[377] But Huxley seems to have had at least some scientific doubts about the adequacy of natural selection, and mainly favoured 'Darwinism' because of its naturalism. E. Mayr, *Growth of Biological Thought* (1982), pp. 510-511 [refering to E. B. Poulton. *Thomas Henry Huxley,* in his *Essays on Evolution,* Clarendon: Oxford (1908), pp. 193-219]. Also mentioned by e.g., P. Bowler, *Darwin* (1990), pp. 156-157, 161.

[378] S. Wright, *Evolution in Mendelian Populations* (1931). On the matter of the unit of selection Wright slips back and forth. M. Ruse, *Are Pictures Really Necessary? The Case of Sewall Wright's 'Adaptive Landscapes* (1996), p. 326.

J. Huxley	natural selection, genetic drift, etc.		'biological' concept of species	against sexual selection, population genetics	ardent Darwinian, but ideological disengagement
Th. Dobzhansky	natural selection, genetic drift, etc. (macro-evolution)	groups and individuals	'biological' concept of species	balancing sel., heterozygote superiority, gene interaction	ideological disengagement, pluralism
E. Mayr	natural selection, geographic isolation, founder effect, etc.	species[379] and sub-populations, individuals	'biological' concept of species	allopatric speciation, gene interaction, phenotype	ideological disengagement, emergentism
G. G. Simpson	natural selection, genetic drift, etc.	lines, species	'evolutionary' concept of species	palaeontology, population genetics	contra teleology; but disengagement
K. Lorenz	natural selection, etc.	species[380]	'biological' concept of species	ethology; species altruism	yes, but restricted: fulguration
E. O. Wilson	natural & sexual selection	selfish genes, but also higher levels		explanation of social behaviour	yes (even ethics)
R. Dawkins	gene selection	selfish genes	unit of survival	selfish gene, vehicles, extended phenotype	yes (but reservations)

Table 4: Tentative summary of some 'characteristic features' of theories and authors usually regarded as largely being Darwinian.

Focusing on the most important authors it is, for our purposes, reasonable to focus on the following *three sub-paradigms* within the Darwinian research tradition:

- The subparadigm of individual-Darwinism, focusing on the struggle between single individual organisms. In particular, Darwin's Darwinism in his middle period, which is of high historical importance, falls into this class. However, it would be wrong to assume that individual-Darwinism united all early Darwinians. Darwinism in this early period was very diverse. A. Weismann, the founder of so-called 'neo-Darwinism', may also be treated as an example of this sub-paradigm.
- The subparadigm of probabilistic population genetics. This paradigm is also often denoted as the 'evolutionary synthesis'. We here will distinguish two phases of this synthesis: In its first phase R. Fisher and J. B. S. Haldane introduced the

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[379] E. Mayr, *One Long Argument* (1991), p. 145.

[380] H. W. Ingensiep, *Zur Kontroverse zwischen Soziobiologie und philosophischer Ethik* (1990), p. 55.

probabilistic aspects into the synthesis and put emphasis on single genes within a panmictic gene pool. In the second phase S. Wright, Th. Dobzhansky, E. Mayr and others finished the evolutionary synthesis by introducing population structure into these models and by emphasising additional other evolutionary mechanisms (although natural selection still played a very central role).

- The subparadigm of gene-Darwinism or of the selfish-gene viewpoint. This viewpoint is advocated e. g. by R. Dawkins, G. C. Williams and in some respect by E. O. Wilson. It focuses on single 'egoistic' genes.

The *notion of sub-paradigms* should be understood here only in a loose sense, allowing for some change within a subparadigm. Actually it is argued that the sub-paradigm of the evolutionary synthesis was formed in two phases and that gene-Darwinism already bears germs to transcend itself. The notion subparadigm should emphasise that within the Darwinian tradition one can distinguish relatively coherent (with a 'correlation of parts') approaches that may not be fully commensurable. These sub-paradigms are claimed to be under different 'ontological regimes'[381] and organised by specific central ideas, which are as essential to them as natural selection is to Darwinism in general. The subparadigms occurred mainly diachronic but they may also be advocated by different authors synchronically. Gene-Darwinism became influential in sociobiology, but the evolutionary synthesis remained influential as well and some proponents even strongly attacked gene-Darwinism as 'unfortunate misunderstanding by certain outsiders'[382].

Now the internal history of Darwinism will be expounded discussing the differences between these Darwinian sub-paradigms in detail. Finally, an outline of some recent approaches developed in contrast to the radicalised gene-Darwinian view or in the wrake of other traditions will be given.

4.1 From Darwin to Weismann – The Birth of Darwinism

a) Darwin – Not a Darwinist in the Strict Sense

Charles Darwin (1809-82)[383] himself was *not the founder of Darwinism*, or better, not the founder of the theoretical building blocks which compose Darwinism. Apart from the

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[381] D. J. Depew and B. Weber have argued that the first two of these three sub-paradigms are under different ontological regimes, roughly Newtonian and Bolzmannian (see text), *Darwinism Evolving* (1995), p. 24.

[382] E.g., E. Mayr, *Darwin, Intellectual Revolutionary* (1983/1985), p. 35; see also: E. Mayr, *One Long Argument* (1991), pp. 141-164. E. A. Lloyd, *Structure and Confirmation of Evolutionary Theory* (1993), p. viii. D. J. Futuyma, *Evolutionsbiologie* (1986/1990), pp. 498 f. (D. Futuyma in his textbook advocates the orthodox evolutionary synthesis, only with little extentions).

[383] Today libaries could be filled with books on Darwin's life and influence. An overview of his biographies is given in: R. Colp, *Charles Darwin's Past and Future Biographies* (1989). Here I mention only two bibliographies embedding Darwin in a larger context: A. Desmond, J. Moore, *Darwin* (1991/1992) and P. Bowler, *Charles Darwin* (1990).

cultural and philosophical influences, which may at least be seen as 'co-authors' of the 'Origin' (➲ Chapter 5 on the external history), nearly all components of the theory had first been proposed long before 1859:

The general idea of an actual 'evolving' biological world, was stated in modern times earlier by Buffon (1749), Lamarck (1809) and Geoffroy (1818), and also, by less known authors, Erasmus Darwin (1794), Treviranus (1805), Tiedemann (1808) and others, and later, but still prior to the publication of the *Origin*, by Grant, Chambers, (the late) Owen and Spencer H. Spencer in 1851 even calls it "a trite enough remark that change is the law of all things"[384]. Darwin in his first edition of the *Origin* was rather reserved in mentioning advocates of evolution before him.[385] But since the second edition, Darwin himself listed over thirty-four predecessors, and he was still accused of lack of generosity.[386]

The concept of common descent has already been considered by Buffon, at least for close relatives, such as horses and asses,[387] and in an idealistic sense by L. Oken. Actually a number of authors has developed this idea prior to Darwin, like Kielmayer[388], Geoffroy, Unger[389], Green[390], von Baer and Chambers[391].

Gradualism was advocated by Lamarck and, e. g., by Meckel, Grant or Chambers[392]. The role of geographically isolated populations, which played a certain role for Darwin and later was stressed by the advocates of the 'evolutionary synthesis', had been asserted earlier by von Buch and Wagner.[393]

The mechanism of natural selection was largely formulated by Malthus (1798), and at the time of Darwin it was applied to origin of species by A. R. Wallace as well.[394]

But it was Darwin who had the unique "brilliant mind, great intellectual boldness, and an ability to combine the best qualities of a naturalist-observer, philosophical

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A range of direct sources to Darwin's personal development has been made available by the so-called 'Darwin industry'. Besides scholarly editions of Darwin's publications, also his notebooks and full correspondance are being published in exemplary editions (➲ Bibliography). P. Bowler has pointed out even some decades ago that the focus of the on Darwin in history of evolutionary biology has lead to the neglect of other aspects. *The Non-Darwinian Revolution* (1988), pp. 14-19. This comment would still apply today.

[384] H. Spencer, *Social Statics* (1851), p. 32.

[385] D. Hull stresses Darwin´s differences in his conception of science as a reason for neglecting them, *Darwin and the Nature of Science* (1983), pp. 63 f.

[386] J. W. Burrow, *Editor's Introduction to Darwin's Origin of Species* (1968), p. 27. See the 'historical sketch' in the editions after 1859. They were not very respectable in the scientific pantheon.

[387] E. Mayr, *One Long Argument* (1991), p. 23.

[388] Cf. Th. Bach, *Biologie und Philosophie bei C. F. Kielmeyer und F. W. J. Schelling* (2001).

[389] E. Mayr, *Growth of Biological Thought* (1982), pp. 390-391.

[390] R. Richards, *The Meaning of Evolution* (1992), pp. 74-75.

[391] *Ibid*, pp. 133-134.

[392] *Ibid*, pp. 54, 145.

[393] E. Mayr, *One Long Argument* (1991), p. 32. See also: Darwin's *Notebook D* (Ed. D. Kohn, 1987), orig. p. 69.

[394] Additionally, one may mention the Scottish naturalist P. Matthew who already published the concept of natural selection in his book *Naval Timber and Arboriculture* (1831). However, Matthew did not work out this idea, because, curiously, it seemed to him to be only 'a self-evident fact'.

theoretician, and experimentalist"[395] to merge all those parts[396] into a coherent theoretical whole around the central notion of natural selection and provide a great amount of empirical evidence. For these reasons Darwin indeed deserves to be regarded as *main* founder of what today is called Darwinism.

But apart from not being the *only* founder of Darwinism, throughout most of the different intellectual phases of his life Darwin was not a Darwinist according to today's sense of the word (➲ working definition, p. 102).

Before 1836/1837 Darwin was even a creationist of the brand of W. Paley (1743-1805), who believed in the fixity of species.

However his notebooks and his autobiography show that in 1837 he adopted the belief of transformation[397] and he quickly – though perhaps not directly (➲ p. 167) – dismissed what Mayr called the 'typological concept' of species and replaced it with the so-called 'biological' concept, which is based on the possibility to reproduce. He soon embraced a theory of common descent and of a tree of life.[398] It was only in September 1838, influenced by reading Malthus, that he adopted his concept of natural selection.[399] One might say that, at this point of his life, Darwin almost became a Darwinian, but even he first seemed to continue to believe in a teleological conception of evolution or at least speaks in terms of "a final cause of all this wedgings".[400] In addition, in his first unpublished systematic outlines of his theory, the sketch of 1842 and the 'Essay' of 1844, Darwin still saw transmutation as an "episodic rather than a truly all-pervasive process".[401]

By 1859, when Darwin published the *Origin of Species,* or in full *On the Origin of Species by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life,* he had abandoned any teleological and saltationist concept. For 'the Darwin of the *Origin*', who has been the one of the best-known of the 'different Darwins', natural selection indeed played a crucial role and is even mentioned in the title of the *Origin.* However, in Darwin's theory of natural selection, his theory of variation and environmental elimination, Lamarckian use and disuse still played an important role in producing variation.[402] In this respect Wallace was more Darwinian in today's sense than Darwin was. Additionally, Wallace was the first of the early selectionists to endorse Weismann's thesis that there is no soft inheritance.[403]

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[395] E. Mayr, *One Long Argument* (1991), p. 11.

[396] *Ibid,* Chapter *Ideological Opposition to Darwin's Five Theories,* pp. 35 ff.

[397] S. Herbert in her introduction to Darwin's *Red Notebook* (1836-1837/1980) supports Darwin's account that he indeed arrived at the concept of transformation (at least roughly) in March 1837, pp. 7-11. In his autobiography Darwin himself only mentions opening the first note-book exclusively devoted to the question of the *Origin of Species* in July 1837. *Autobiography* (Ed. F. Darwin, 1887, Charles' org.: 1876), pp. 68, 83.

[398] Ch. Darwin, *Notebook B* (Ed. D. Kohn, 1987), orig. pp. 21, 26, 36, 97.

[399] *Idem, Notebook D* (Ed. D. Kohn, 1987), orig. p. 135e.

[400] *Ibid,* org. p. 135e. See also: D. Kohn, *Introduction to Notebook D* (1987), p. 330.

[401] P. Bowler, *Charles Darwin* (1990), p. 99 (refering to D. Ospovat, 1981), ➲ footnote 686.

[402] Ch. Darwin, *Notebook D* (Ed. D. Kohn, 1987), pp. 173 ff.

[403] E. Mayr, *The Growth of Biological Thought* (1982), p. 586.

Also, most of the Victorian early followers of Darwin still believed in several mechanisms of evolution and favoured orthogenesis or Lamarckian evolution. Although the influence of Darwinism was increasing in the 1860s and 1870s, Darwinism was often not very strictly interpreted. Also E. Haeckel (1834-1918), the most influential early German advocate of 'Darwin's theory of descent', was at odds with Weismann's pure doctrine of neo-Darwinism and furthermore argued in favour of a more directed evolution. Even Th. H. Huxley and A. Gray were even less strict Darwinians than Darwin himself was. P. J. Bowler has worked out that many early self-proclaimed Darwinians were still only "pseudo-Darwinians", and that at least many – if not most – of the post-*Origin* nineteenth century evolutionists retained a developmental, more "orderly, goal-directed, and usually progressive" understanding of evolution. According to Bowler not only Darwinians but often non-Darwinians also played a role in building up a "creation myth" of evolutionary theory, thus overestimating the immediate influence of Darwin.[404]

The tolerant stance of Darwin and his early followers in regard of other evolutionary mechanisms is not only due to the fact that the moral consequences of a pure theory of natural selection were so unpalatable, but this attitude was at least partly borne out of the general ignorance of Darwin's time concerning the process of inheritance. Accordingly Darwin in the *Origin* treated the process of inheritance like a black box.

In *Variation of Animals and Plants under Domestication* (1868) Darwin gave an account of his theory of inheritance, the 'provisional hypothesis of pangenesis': Particles present in all cells of the body, so-called 'gemmules', are modified according to use and disuse and are transported throughout the body. They accumulate in the sexual organs.[405] Thus, especially Darwin's later theory became less Darwinian in assuming that the inheritance the phenotype *does* directly affect the genotype.

Moreover, as Darwin worked on non-sexual plants, he also became confused again concerning the definition of species and returned to a rather typological definition.[406]

In the *The Descent of Man and Selection in Relation to Sex* (1871/1874) Darwin still adheres to the theory of pangenesis.[407] He even concedes that he "perhaps attributed too much to the action of natural selection or the survival of the fittest"[408] and because of this he also altered the fifth edition of the *Origin*. Although he even at that time did not gave up his central concept of natural selection, he at least gave room for sexual selection, correlation of growth, use and disuse, and even abandoned a strict adaptionism (➲ pp. 113).

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[404] P. Bowler, *The Non-Darwinian Revolution* (1988), esp. pp. 5, 16, 76 f., 105-107, 175; *Charles Darwin* (1990), pp. 81, 155-161, 166. Also e.g., R. J. Richards argued that most Victorian Darwinians were not materialists in the later sense of Darwinism, *Darwin and the Emergence of Evolutionary Theories of Mind and Behavior* (1987), esp. p. 543.

[405] See e.g., E. Mayr, who distinguishes two subtheories of pangenesis, *Growth of Biological Thought* (1982), pp. 693 f.

[406] E. Mayr, *One Long Argument* (1991), pp. 29-30, 57, 69-70. See also: A. Desmond, J. Moore, *Darwin* (1991/1992), p. 189.

[407] Ch Darwin, *The Descent of Man* (1874/1922), pp. 352-357.

[408] *Ibid,* Chapter II, p. 91.

To summarise, Darwin in opposition to modern neo-Darwinism (➲ pp. 118 f.; p. 102) advocated other mechanisms than selection. Even in the *Origin of Species,* Darwin's most 'Darwinian' book, he is – expressed in a modern way – convinced of a flux of information from the 'phenotype' to the 'genotype'. Darwin on the one hand still could be regarded as the main founding father of Darwinism, because it was he, who first gave natural selection its central place in a theory of evolution, on the other hand Darwin was not a pure Darwinist in the today's understanding; in our today's understanding he was both a Darwinian and a Lamarckian.

b) Darwin's Biological Theory – Focus on the Individual Organism

Darwin, because his emphasis on natural selection could still be regarded – despite the above qualifications – as the main proponent of the first 'subparadigm' of Darwinism (For an account on the external influences on Darwin's theory, ➲ pp. 152 ff.).

At the very heart of Darwinism in general, closely linked to the notion of natural selection, which is – roughly speaking – common to all different subparadigms of Darwinism and even only seldom questioned in the recent unit of selection debate, is Darwin's concept that natural selection works "solely by and for the good of each being"[409]. Thereby Darwin implicitly introduces what I want to call the '*principle of egoism*'. This metaphysical principle may be stated explicitly in the following way: Any entity is by definition egoistic because an entity which shows the property of caring for itself is by definition an existent entity and not only an epiphenomenon or a side effect of another entity. We may express this principle in the statement 'no entity without egoism, no egoism without entity'. We come back to this point in the more philosophical part of this work (➲ pp. 418 f.).

But based on the notion of natural selection and the principle of egoism different levels of existence could still be proposed, like Nature or God as a whole (like in Spinoza's one substance ontology), ecosystems, species, groups, organisms or single genes. We will now outline Darwin's theory, emphasising the differences of Darwin's own theory compared with Wallace's selection theory or to later schools of Darwinism, especially in regard to the focused evolutionary entity.

The *differentia specifica* of Darwin's subparadigm of Darwinism, apart from his still present Lamarckian tenets, is his *focus on the individual organism.*[410] E. Mayr claims: "The importance of the individual became the cornerstone of Darwin's theory of natural selection"[411].

Correspondingly, Darwin, at least at the time of the *Origin of Species* defined species and even varieties in a nominalistic way. Darwin advocated a continuous variation of forms of the same descent. Type or form could be explained by common descent.

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[409] Ch. Darwin, *Origin of Species* (1859), p. 459.

[410] Similar: M. Ruse, *Charles Darwin and Group Selection* (1980/1989). Ruse at that time did not distinguish between gene-Darwinism and individual-Darwinism and hence his speculation what preferences Darwin would have today may consequently yield inadequate results. But: M. Ruse, *Sociobiology and Reductionism* (1989), pp. 47 f., 61 f.; *Mystery of Mysteries* (1999), p. 126.

[411] E. Mayr, *One Long Argument* (1991), p. 42.

Darwin at that time clearly was a nominalist and all genera and even species and varieties are artificial and arbitrary notions:

> "[...] I look at the term species, as one arbitrarily given for the sake of convenience to a set of individuals closely resembling each other, and that it does not essentially differ from the term variety, which is given to less distinct and more fluctuating forms."[412]

Therefore – in contrast to proponents of the later synthetic theory of evolution – to Darwin species and varieties are as unreal as higher genera are. The similarity of representatives of species and of genera is due to common descent. The species of the large genera are related to each other, in the same manner as the varieties of any one species are related to each other. [413]

> In the 1860s, Darwin's interests have turned to botany and he came back to an at least slightly more typological definition of species.[414] It has been argued that he even then retained his view that evolution selects only for the good of the single organism.[415]

Only individuals are selected and only properties beneficial to individuals can evolve. Something can evolve, "[...] only so far as it profits the individual in its complex struggle for life [....]".[416]

Since Darwin emphasised the individual and individually inherited variations, he comes to the conclusion that the competition mainly takes place among individuals *within* a population. It has to be conceded, that in the *Origin* Darwin in the one case of sterile castes of insects was forced to assume something like group selection.[417] Despite this, the obvious essence or core of his subparadigm is the struggle between individuals of the same species:

> "[...] the struggle almost invariably will be most severe between the individuals of the same species, for they frequent the same districts, require the same food, and are exposed to the same dangers. In the case of varieties of the same species, the struggle will generally be almost equally severe [...]."[418]

In the *Descent of Man* – as will be shown in the next section – Darwin appears to have been only a bit more positive towards the concept of *group selection.* Although being more ambivalent on this matter, especially in regard of humans, Darwin still generally held a rather individualist stance.

Darwin's individualist view may seem a necessary pre-Mendelian view of Darwinism. But this is not the case. It is interesting that the co-founder of the theory of natural

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[412] Ch. Darwin, *Origin of Species* (1859), p. 108, see also: pp. 112, 455-456.

[413] *Ibid,* p. 111.

[414] E. Mayr, *One Long Argument* (1991), esp. p. 30, ➲ footnote 406.

[415] M. Ruse, *Charles Darwin and Group Selection* (1989/1980), pp. 41-47.

[416] Ch. Darwin, *Origin of Species* (1859), p. 348.

[417] Ch. Darwin, *Origin of Species* (1859), Chapter on instincts, p. 258. (Because of Darwin's predominant focus on the individual this might be seen as an ad hoc hypothesis to explain an anomaly in his subparadigm. Still there are authors who mention him as introducing the concept of group selection e.g., E. O. Wilson, *Sociobiology* (1975), p. 106.)

[418] *Ibid,* p. 126.

selection, *Alfred Russell Wallace* (1823-1913) – who generously introduced the term 'Darwinism'[419] –, in many respects drew different conclusions. For Darwin, competition takes place among individuals *within* groups of closely related individuals; Wallace (a later socialist and then spiritualist) by contrast, stressed competition *between* closely related species. Darwin thought that individual competition favours only the *very fittest*, whereas Wallace thought it eliminated those varieties that were *totally unfit*. Hence, the main disputes within Darwinism were introduced by its first proponents, Darwin and Wallace: competition versus co-operation; individual selection versus group selection; and positive versus negative selection.[420]

c) Darwin's Descent of Man – Social Darwinism?

In the *Origin*, Darwin guardedly and mysteriously forecasted that "[l]ight will be thrown on the origin of man and his history"[421] – in the *Descent of Man and Selection in Relation to Sex* (1871/1874) he actually applied his theory to the origin of mankind. We (1.) point out some changes in Darwin's biological theory, as he applied it to humans, and (2.) look how far he assumed that the theory will also explain, higher human faculties, culture and ethics.

(i) Ambivalence about the Universality of Natural Selection

In the 'biosociological' (➲ p. 29) book *Descent of Man* he presumably found difficulty in confining himself to his own paradigm, although Darwin earlier could "not avoid the belief that man must come under the same law"[422]. This book is ambivalent about the universality of natural selection and – as will be shown afterwards – towards the individualist focus of natural selection.

On the one hand, it appears that Darwin wanted to maintain his belief of one universal law governing the process of evolution (➲ also p. 163). Thus he stated that the development of the human being obeyed "the same general laws, as with the lower animals".[423] This conception was stated repeatedly in this work.[424] Hence, to Darwin "the difference in mind between man and the higher animals, great as it is, certainly is one of degree and not of kind."[425]

On the other hand, being concerned with the evolution of man, it seems that he had tried to a certain degree to change his view on the universality of the mechanisms of evolution.

First, Darwin was an exceptionally humane man, and from the time when Darwin became largely a Darwinian in the modern sense of the word, he was shaken by the 'remorseless struggle'. His moderate changes of his genuinely mono-mechanistic

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[419] A. R. Wallace, *Darwinism: An Exposition of the Theory of Natural Selection* (1889).

[420] M. J. Kottler, *Charles Darwin and Alfred Wallace* (1985), quoted in D. J. Depew, B. Weber, *Darwinism Evolving* (1995), pp. 75-76.

[421] Ch. Darwin, *The Origin of Species* (1859), p. 458.

[422] Ch. Darwin, *Autobiography* (Ed. F. Darwin, 1887, Charles' org.: 1876), p. 93.

[423] *Idem*, *The Descent of Man* (1874), Chapter II, p. 71.

[424] *Ibid,* e.g., pp. 43, 52, 93, *94*, 928.

[425] *Ibid,* Chapter IV, p. 193.

approach might partly be due to his wish to reach what were morally at least bearable results.

Secondly, Darwin's own theory had at that time already largely undermined his own deistic underpinnings, which might be seen as the main cause of his former belief in an ubiquitous eternal law of nature.

Thirdly, Darwin's belief in the progress in nature by the simple process of natural selection (which was still present in the *Origin*) was shattered. As he himself concedes, he had to abolish his strict adaptationist view.[426]

> In fact, it seems controversial whether Darwin's account is essentially *progressionist or not.* For example Bowler and Gould have argued that Darwin's theory – although often misinterpreted by early Victorians – does not allow the concept of a progression of populations because they always adapt only to local environments. Richards shows that in the *Origin* a belief in a progression at least based on environmental forces could be found and that progress was the intended consequence of Darwin's theory.[427]
>
> These views may be reconciled if we argue that Darwin first built his pan-selectionist, pan-adaptionist and hence progressionist and mono-mechanist theory on what was still a partly theological Paleyan basis. Darwin, at the time of the *Origin*, like Adam Smith, still optimistically and undiminishedly believed that by the egoistic individualist mechanism he found, still "all corporeal and mental endowments will tend to progress towards perfection."[428] But later on, Darwin on the basis of the selection theory he himself had developed, could neither sustain a theological basis for these tenets nor the biological claims in their wake (➲ 'external history', pp. 162 f.).

Hence, connected with his doubts about pan-adaptionism he emphasised, more than before, a certain *causal pluralism.* He even explicitly stated that he might have overemphasised the importance of natural selection.[429] It is still the case that natural selection was a more important mechanism of evolution of man to Darwin than for example for Wallace[430] and Spencer[431]. But compared with the *Origin,* he is less Darwinian in the *Descent of Man.* He did not only give up his belief in adaptationism, but largely replaced natural selection by sexual selection. To explain variation he again employed the concept of use and disuse[432] and now also an originally romantic concept, that of the correlation of parts[433].

Moreover, in regard to the 'object' of the mechanisms of evolution, Darwin – as we have seen above – still largely seems to have advocated selection of individuals, but is less clear about his position and wavered between the concept of individual selection and the additional concept of group selection at least in the exceptional case of the development man and morality.

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[426] *Ibid,* Chapter II, p. 92, also ➲ footnote 751.

[427] R. Richards, *The Meaning of Evolution* (1992), pp. 84-90, 177 f.

[428] Ch. Darwin, *Origin of Species* (1859), p. 459.

[429] Ch. Darwin, *The Descent of Man* (1874), pp. 91-93, ➲ footnote 408.

[430] *Ibid,* p. 73.

[431] J. C. Greene, *Darwinism as a World View.* In: *Science, Ideology and World View* (1981), p. 138.

[432] Ch. Darwin, *The Descent of Man* (1874), Chapter II, pp. 47-52, see also pp. viii, 928.

[433] *Ibid,* pp. 64-65, 91.

Apart from the question concerning the mechanisms of evolution, Darwin also changes his view on the question which entity is the *'object' of these mechanisms* in this later writing. Darwin – as we have seen – in the *Origin* had focused on the individual organism as the only real entity, as the source of variation and as the sole agent in the struggle of life.

In the *Descent of Man* he appears to be a bit more positive towards the concept of *group selection*, although he admittedly stayed ambivalent and still largely took an individualistic stance.[434]

As in the *Origin*, he clearly advocated group selection, discussing group behaviour of ants and bees:

> "With strictly social animals, natural selection sometimes acts on the individual, through the preservation of variations which are beneficial to the community. A community which includes a large number of well-endowed individuals increases in number, and is victorious over other less favoured ones; even although each separate member gains no advantage over the others of the same community."[435]

But Darwin now additionally advocated the conception of group selection not only in regard to castes of sterile insects, but in regard to the development of mankind and the gain of mental powers.[436] But even in regard of mankind Darwin was still wavering between his original concept of individual selection and an additional acceptance of group selection. Darwin already discussed the problem that egoistic individuals could override a group of more socially orientated individuals. Darwin in some remarks quite clearly stated a predominance of the individual level: with "the higher social animals, I am not aware that any structure has been modified solely for the good of the community, though some are of secondary service to it."[437]

However, in many cases it is not clear whether Darwin only stated his former confident belief that the action of self-interested *individuals* fighting for their own survival would also lead to the benefit of the group or species as a whole, or if he actually believes in something like group selection, where the group is an entity in its own right.[438]

Thus in the *Descent of Man* Darwin, while abandoning pan-adaptionism and allowing some causal pluralism, was, at least in the exceptional case of mankind, wavering between the concept of individual selection and the additional concept of group selection.

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[434] M. Ruse argued that Darwin in his book *Descent of Man* quite clearly took an individualistic stance, *Charles Darwin and Group Selection* (1980/1989), pp. 47-52, ➲ footnote 410. Based on unclear sections of the original text some authors have interpreted this differently. E.g., R. Richards, *Darwin and the Emergence of Evolutionary Theories of Mind and Behavior* (1987), pp. 599-601. A. Rosenberg, *Altruism Theoretical Contexts* (1992/1998), pp. 449-450.

[435] Ch. Darwin, *The Descent of Man* (1874), p. 94.

[436] *Ibid,* Chapter II, p. 95 and Chapter V, p. 200, 203.

[437] *Ibid,* pp. 94-95.

[438] *Ibid,* Chapter VIII, p. 370, see also p. 933 f.

(ii) Explaining Man, Culture and Ethics?

In correspondence with Darwin's ambivalence in regard to the universality of the evolutionary mechanism and in regard to group selection, there is a general ambivalence as to how far his theory of evolution could be applied to explain even higher human capacities. Here we only deal with the question in which way and how far Darwin intended to apply his theories to human beings as well; whereas the social influences on Darwin and Darwinism will be treated in Chapter 5 (➲ particularly, pp. 173 f.).

Darwin's belief in a tree of life and in a common decent of all human races seems to have been consonant to his abolitionist political position.[439] But it should be noted that such positions also have been held without evolutionist leanings.[440]

We are here concerned more specifically with the notion of natural selection. Within the history of science, the question whether Darwin's approach to culture goes so far to be called socio-Darwinian, is quite controversial.[441] T. H. Huxley, for example, who, like Haeckel, was regarded as one of Darwin's 'bulldogs', much more clearly than Darwin in his later development turned against natural selection and struggle for life as a prescription for human culture and ethics: "Let us understand, once for all, that the ethical progress of society depends, not on imitating the cosmical process, still less in running away from it, but in combating it."[442] Scholarship has shown that Huxley should anyhow rather be regarded as a 'pseudo-Darwinian'.[443] However, Darwin, in contrast, in the *Descent of Man* had given reason to assume that he was at least ambivalent towards the question of whether 'higher human capacities' could also be explained by his (modified) biological theory:

(1) On the one hand, from time to time Darwin (the former student of theology) sounds relatively *moderate* or *guarded*. Darwin does not state clearly that he thought that morals and ethics ought to be 'biologised'. This might be partly due to his social background and to the fact that he did not want to evoke more dismay than necessary in public and to his sincerely pious wife, Emma. Sometimes he even seems to refer to an independent cultural sphere and to an own inner logic of reason and religion:

> "For the moral qualities are advanced, either directly or indirectly, much more through the effects of habit, the reasoning powers, instruction, religion, & c. than through natural selection."[444]

To refer to an inner necessity of reasoning powers may be seen rather as reminiscent of a romantic, structualist view, than of a Darwinian one. It seems almost ironic, that

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[439] For a detailed account, see: J. Moore, A. Desmond. *Darwin 's Sacred Cause* (2009).

[440] For instance, Darwin had adopted his abolitionist position on the HMS Beagle when still being a strict believer of Paley's natural theology. Likewise the important British philanthropist William Wilberforce was deeply religious.

[441] J. C Greene, *Darwin as a Social Evolutionist* (1977/1981), pp. 95 ff.

[442] T. H. Huxley, *Evolution and Ethics and Other Essays* (1895), p. 83.

[443] P. Bowler, *The Non-Darwinian Revolution* (1988), pp. 68, 70, 76 f., ➲ footnote 404.

[444] Ch. Darwin, *The Descent of Man* (1874), Chapter XXI, p. 945.

Darwin states that moral development relies also on religion, which he himself had involuntarily at least partly undermined.[445]

Moreover, as outlined before, he tried to explain the Origin of Man not by *natural*, but by *sexual* selection, which he had only briefly mentioned in the *Origin*.[446] It has been argued that even this emphasis, to a certain extent, was forced on him in countering Wallace, who had argued that the human development calls for explanations above the process of natural selection.

Sexual selection "depends on the advantage which certain individuals have over others of the same sex and species solely in respect of reproduction."[447] The struggle is focused on the "males for the possession of the females".[448] The reason that sexual selection comes into being is that it serves survival in terms of natural selection: "It has been shewn that the largest number of vigorous offspring will be reared from the pairing of the strongest and best-armed males, victorious in contests over other males, with the most vigorous and best-nourished females [...]"[449]. Although Darwin often sounds as if sexual selection in principle could be reduced to natural selection, he still pointed out that practically "[s]exual selection acts in a less rigorous manner than natural selection"[450].

(2) On the other hand, Darwin sometimes seems to have taken a more rigorous *biologistic stance*. In this regard he is mirrored by parts of today's sociobiology and also by the so-called 'socio-Darwinians'.

> Early 'socio-Darwinians' gave a naturalistic biologistic account of human activity and applied Darwin's theory of evolution, especially his theory of natural selection also to humans. But some of them, like Spencer – like even Darwin himself – still believed in an important role also for acquired characteristics, so that we today would regard them to a certain extent also as 'socio-*Lamarckians*'[451].

Darwin argued that genius and insanity is inherited.[452] This is according to Darwin also the case in regard to the intellectual differences of the sexes:

> "The chief distinction in the intellectual powers of the two sexes is shewn by man's attaining to a higher eminence, in whatever he takes up, than can woman – whether requiring deep thought, reason, or imagination, or merely the use of the senses and hands. If two lists were made of the most eminent men and women in poetry, painting, sculpture, music [...], history, science, and philosophy, with half-a-dozen names under each subject, the two lists would not bear comparison. We may also infer, from the law of the deviation from averages, so

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[445] Darwin might have thought positivistically – like T. H. Huxley – that religion applies to the past and not to the future.

[446] Ch. Darwin, *The Descent of Man* (1874), Chapter VII pp. 307-308, whole Part III.

[447] Ch. Darwin, *The Descent of Man* (1874), Chapter VIII, p. 322.

[448] *Ibid,* p. 328.

[449] *Ibid,* p. 340.

[450] *Ibid,* p. 349.

[451] P. J. Bowler, *Darwin* (1990), pp. 169-172, esp. 171, ➲ footnote 460.

[452] Ch. Darwin, *The Descent of Man* (1874), Chapter II, p. 41, see also pp. 81 ff. Darwin refers here like in the next quote to the work of his cousin Francis Galton, *Hereditary Genius: An Inquiry into its Laws and Consequences* (1869).

> well illustrated by Mr. Galton, in his work on 'Hereditary Genius', that if men are capable of a decided pre-eminence over women in many subjects, the average of mental power in man must be above that of woman."[453]

Although Darwin concedes that this mental inferiority of women could be superseded; to him this is mainly a biological problem – problem a breeder has with its cattle:

> "All women, however, could not be thus raised, unless during many generations those who excelled in the above robust virtues were married, and produced offspring in larger numbers than other women."[454]

Because of this biologistic views, Darwin even sometimes takes a prescriptive 'socio-Darwinian' view, in the sense that he draws far-going normative conclusions from his biological conception:

> "We civilised men, on the other hand, do our utmost to check the process of elimination; we build asylums for the imbecile, the maimed, and the sick; we institute poor-laws; and our medical men exert their utmost skill to save the life of every one to the last moment. [...] Thus the weak members of civilised societies propagate their kind. [...] but excepting in the case of man himself, hardly any one is so ignorant as to allow his worst animals to breed."[455]

But – perhaps because of his former Christian background – Darwin in this context shrunk back from directly calling for the abolition of the Poor Laws, as Malthus[456] and Spencer[457] – for maybe different reasons – in fact did. But on other pages Darwin indeed considered that "it might be argued that the struggle for existence had not been sufficiently severe to force man upwards to his highest standard".

J. C. Greene, also looking through Darwin's annotations of books and articles, has shown, that Darwin, at the time he wrote the *Descent of Man,* was to a large extent convinced that his ideas of struggle for life have to be applied to culture as well and in this sense could be said to have shared socio-Darwinian ideas. [458] Already Hofstadter in his canonical book on socio-Darwinism has pointed out that the term 'Socio-Darwinism' had been used with meanings besides laissez-faire capitalism, i. e. struggle between nations or artificial breeding policy.[459] Bowler even pointed out that it was possible to associate almost every social and political position to biological 'Darwinism' – but I think this had only been the case if we take the wide Victorian understanding of 'Darwinian' biology into account, which Bowler himself has illustrated.[460] Apart from this, I think Greene is right in arguing that Darwin, based on *his* biological theory, Spencer, Th. H. Huxley and Wallace on partly indeed different

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[453] Ch. Darwin, *The Descent of Man* (1874), Chapter XIX, pp. 857 f., see also p. 847.

[454] *Ibid,* p. 861.

[455] *Ibid,* Chapter V, pp. 205-206.

[456] On Malthus ➲ pp. 174 f..

[457] H. Spencer, *Social Statics* (1851), pp. 311-329.

[458] J. C. Greene, *Darwin as a Social Evolutionist* (1977/1981), pp. 95-127.

[459] R. Hofstadter, *Social Darwinism in American Thought* (1955).

[460] P. J. Bowler, *The Non-Darwinian Revolution* (1988), pp. 152-173, esp. 155, 161, 165, 171; *Evolution* (1984), pp. 266 f. Also: M. Hawkins, *Social Darwinism in European and American Thought, 1860-1945* (1997).

grounds, by 1860 had reached a world-view focused on the idea of competitive struggle and survival of the fittest.[461] However, the specific way Darwin argues, – I think – is not *only* due to an arbitrary construction on top of his theory, but is at least partly born out of the construction of his biological theory.

Still one might imagine Darwin even more vigorously arguing against poor laws and the like. In my opinion, Darwin's still detectable ambivalence in applying his original struggle-for-life-view of nature also to humans partly refers us to his ambivalence in regard to the universality of natural selection, his Lamarckian tenets and the modifications of his theory, which is vice versa connected with his attempt to apply his theory to mankind. In conclusion, Darwin became a '*Socio-Darwinist*' not in a purely Darwinian sense, not even in the sense of the Darwin of the *Origin of Species*, but – here I agree to Greene – still in the sense of his own, a bit more moderate, biological theory of the *Descent of Man*.

In summary, Darwin in the *Descent of Man* put more emphasis on use and disuse, correlation of parts etc. than in the *Origin* and he also emphasised the concept of sexual selection. Yet, Darwin generally can be said to have remained quite steadfast in his basic faith that natural selection and struggle for life play at least a crucial role, even if this theory is applied to mankind.

Already in the *Origin of Species* Darwin was not a Darwinist in today's strict sense of the word, but still to some degree was e. g. a Lamarckist. Nevertheless, he introduced the concept of natural selection as a central mechanism of evolution. Besides his still vague view on inheritance etc. his subparadigm in the *Origin* is characterised by his focus on the individual organism as the source of variation, as the only real entity and therefore the unit of selection, of evolution and of the struggle for life.

In the *Descent of Man*, Darwin introduced a limited causal pluralism, but he seems still to have explained the evolution of 'lower' animals and of man by an unchanging universal set of laws. He generally estimated natural selection to be less important and also considered group selection at least for humans. Still at least in this moderated sense he applied his theories also to human capacities and culture.

d) Neo-Darwinism: Weismann Turns Darwin's Theory into 'Darwinism'

At Darwin's times, the mechanisms of inheritance were still totally obscure. Linked to this ignorance was Darwin's problem of how variability could arise on which natural selection then could act. "With respect to the causes of variability, we are in all cases very ignorant"[462]. Correspondingly, – as we have seen before[463] – Darwin in the *Origin* and even more in the *Descent of Man* still relied on inheritance of acquired characters and correlation of parts.

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[461] J. C. Greene*, Darwinism as a World View.* In J. C. Greene, *Science, Ideology and World View* (1981), pp. 148-150. Even P. J. Bowler concedes that the struggle metaphor was at variance with a formerly more directed and purposeful notion of evolution, *The Non-Darwinian Revolution* (1988), pp. 156, 165.

[462] Ch. Darwin, *The Descent of Man* (1874), Chapter II, p. 41.

[463] In this respect Darwin was not a Darwinist, ➲ 106 f..

August Weismann (1834-1914) was an ardent supporter of the theory of natural selection and since 1882 rejected the concept of use inheritance. Because of this, George Romanes, a disciple of Darwin, who himself did not want to abandon the Lamarckian elements in Darwin's theory,[464] coined the term '*neo-Darwinism*' for Weismann's radicalisation of Darwin's original more moderate theory. Neo-Darwinism later on, after the crises of Darwinism and neo-Darwinism at the turn of the century, only became dominant under the again quite different regime of the evolutionary synthesis. As there were almost no original Darwinians left, people started to use 'Darwinism' for short, instead of the literally more correct terms 'neo-Darwinism' or 'Weismannism'.

In *Weismann's intellectual development three main periods* could be distinguished:[465]

- Already from 1868 to 1881 Weismann ardently supported natural (and sexual) selection. But nevertheless he believed at the same time in inheritance of acquired characteristics. Like Darwin, he thought that use inheritance produces the variability on which natural selection could act.
- From 1882 to 1895 Weismann had dismissed the theory of use-inheritance and offered an alternative theory of inheritance. At that time he was almost totally a panselectionist on the level of the individual organism.
- From 1896 to 1910 Weismann deviated from his panselectionist view. Despite having found a theory of inheritance which made the inheritance of acquired characters impossible, he still failed to give a convincing account of how variation is sustained. Lacking theories of mutation and population genetics, he had to accept that a mere chance combination and blending inheritance could not provide enough variation. Hence he had to introduce other mechanisms, mainly his theory of cell selection, germinal selection and even a theory of 'induced germinal selection'. At this time he revoked his former strictly neo-Darwinian beliefs and again emphasised sexual selection and also other mechanisms.

In Weismann's middle period he stated in *his theory of inheritance*, that there is only one direction of information flux: we today would say 'from the genotype to the phenotype'. Besides his theoretical considerations he also refuted inheritance of acquired characters by experiment: Selective breeding of the largest and the smallest individuals of pure lines, which are only due to environmental conditions of different height, should produce progressive results. Such experiments, which were conducted till the 1930s and 40s, came uniformly to negative results.[466]

In *Das Keimplasma: Eine Theorie der Vererbung* (1892) he gave a full account of his theory, called germ-plasma theory of inheritance, based on the cell nucleus theory of M. Schleiden, T. Schwann and R. Virchow.

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[464] E.g., R. J. Richards, *Darwin and the Emergence of Evolutionary Theories of Mind and Behavior* (1987), pp. 334 f.

[465] See: E. Mayr, *Weismann and Evolution* (1985), pp. 296 f.; *One Long Argument* (1991), pp. 111 ff.

[466] E. Mayr, *Growth of Biological Thought* (1982), p. 700.

Weismann advocated a continuity of the germ plasma (*Keimplasma*) which, according to him, is unaffected by any change of the soma plasma (*Somatoplasma*). This conception could not only be applied to the *nucleus* and *soma* of *single* cells, but to the relation of whole germ *cells* and somatic *cells* (cf. Figure 2).

Weismann's much more complicated theory of inheritance got, from the viewpoint of today's biology, something wrong. He did not approve an 'activation' theory of the germ plasma but a 'dissection' theory: he thought that "the chromatin which controls them [the cells] cannot be the same in every cell but must differ according to the nature of the cell".[467] Here Weismann was corrected by the research of Spemann, Driesch and others who emphasised the role of the location of cells in the whole organism. Despite this, Weismann has to be regarded as founder of what was later called the *central dogma of molecular biology:* no information could be passed from the phenotype to the genotype, from any cell molecules to the DNA.

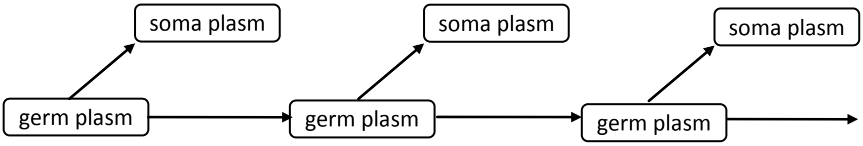

Figure 2: Flux of information in Weismann's *Keimplasmatheorie.*

By doing this he ruled out inheritance of acquired characters and also Darwin's theory of pangenesis, and by this the way was prepared for his version of panselectionism. In his middle period he also became critical towards sexual selection.[468] Natural selection was to him, at that period, although still not totally breaking with developmental constraints, almost the only mechanism of evolution. In the beginning this was accompanied by a belief in panadaptionism, and only after he became an ardent selectionist he realised (as had Darwin before him) that natural selection does not necessarily lead to perfection.[469]

Another aspect concerning our comparison of Darwinian subparadigms is that Weismann in his middle period – like Darwin in the *Origin* – focused on the level of the *individual* as an object of selection, while the individual is either seen as phenotype or as holistic genotype.[470]

Although Weismann should be seen as clearly Darwinian arguing against a romantic understanding of a preformed 'evolution', he in a limited sense not only undermined, but continued this tradition which was especially strong in Germany: he applied preformationism now with a materialist spin only to the problem of

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[467] A. Weismann, *Keimplasma* (1892), p. 43, quoted in E. Mayr, *The Growth of Biological Thought* (1982), p. 702.

[468] E. Mayr, *Weismann and Evolution* (1985), p. 309.

[469] *Ibid,* p. 308.

[470] E. Mayr, *Weismann and Evolution* (1985), pp. 308-309; *One Long Argument* (1991), pp. 117, 130.

ontogenesis and exactly by this he made the phylogenetic preformationism impossible, which had been central to romantic biology and had been based on *causa formalis*.

Weismann became Darwin's executor in finding a theory of inheritance which allowed an exclusive focus on Darwin's theory of natural selection; he radicalised Darwin's theory by ruling out causal pluralism still employed by Darwin himself and replaced it by his own panselectionist theory.

Hence Weismann with even more reason than Darwin himself, could be called a Darwinian in the sense of our working definition. Because Weismann focused on the individual or on the genotype as a whole he has been treated here under the subparadigm of individual-Darwinism.

After Weismann had refuted romantic biology and Lamarckian inheritance of acquired characters, his panselectionist theory had the majority of supporters during the 1880s.

4.2 Darwinism on Its Deathbed

In the 1890s the influence of Weismann, and with this the influence of Darwinism, faded again and was not dominant until the occurrence of the evolutionary synthesis in the 1930s and 1940s. Victorian 'Darwinism', as P. J. Bowler has shown, had anyway not been a pure form of Darwinism. At any rate, after the short success of Weismann's mono-mechanistic purer brand of Darwinism, most biologists at the end of the century turned against this radicalised form of Darwin's theory. This might partly be due to the perhaps over-ambitious attack of Weismann upon other forms of explanation. At the time Weismann overcame the concept of use-inheritance, he was still not able to provide another explanation of how variance is sustained, a necessary precondition if the mechanism of natural selection was to be accepted.

Although natural selection was still one among other discussed factors of evolution – and no doubt still had some (subliminal) influence on other areas of human activity even at that time –, Weismann's attack on causal pluralism ended in a strong backlash in biology. During about 40 years the majority of biologists regarded themselves as followers of (1) neo-Lamarckism, (2) a theory of orthogenesis or (3) a Mendelian kind of saltationism.[471]

(1) Neo-Lamarckism in the narrow sense mainly focused on use inheritance. Often this term is used as in the broader sense as umbrella notion also for the other non-Darwinian schools.

> Social-*Lamarckism,* in the narrow and in the broad sense, was present in the works of Joseph LeConte, Lester Ward, the psychologist G. Stanley Hall and the playwright George Bernhard Shaw. Apart from Spencer who at least partly was an early 'social-Lamarckist'

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[471] This division of different schools is adopted from E. Mayr*, The Growth of Biological Thought* (1982), pp. 525-531. See also: P. J. Bowler, *Evolution*: *The History of an Idea* (1984), pp. 243-265; St. J. Gould, *The Structure of Evolutionary Theory* (2002), pp. 351 f., on orthogenesis; P. J. Bowler, *The Eclipse of Darwinism* (1983).

> these conceptions were often linked with the goal of social reform and state education and an opposition towards *laissez-faire*.[472]

(2) The conception of orthogenesis resembles the tenet of romantic biology to focus on an inner tendency, a necessary unfolding of nature. The romantic idea culminates in the gain of self-consciousness of nature or God. In the second half of the 19th century the concept of orthogenesis was either combined with physicalism or with finalism, interestingly both turning against the turning against the Darwinian surrender to chance. Among the proponents of orthogenesis were Carl von Nägeli (a former student of Oken), Theodor Eimer, Leo S. Berg, Edward Drinker Cope, Henry Fairfield Osborn, as well as the Jesuit and palaeontologist Pierre Teilhard de Chardin. In this context the vitalists Hans Driesch and Jakob von Uexküll should also be mentioned, as these authors emphasised the non-reducibility of biology to physics. They referred – often in a somewhat mystical way – to vital forces. Driesch also reintroduced the teleological Aristotelian concept of *entelecheia*. Generally vitalism was influenced also by German *Gestalt*-psychology.[473] Like this school they were opposed to reductionism and atomism. Also the process philosophy of A. N. Whitehead – although different in form and background – resembles this general position.

(3) Saltationism was also already a tenet of romantic biology. Romantic biologists favoured this concept largely because of their belief in given forms. Today this idea might be easier to understand, if we use the term 'ecological niche', into which a species only suddenly 'slip'. However, saltationism traditionally has corresponded to the belief in an essence of a species.[474] Darwin, in contrast, had favoured a species nominalism and a gradualist view of evolution.

In 1900 three European biologists, among them Hugo de Vries (1848-1935), rediscovered the laws of heredity already developed and published in the year 1866 by the Austrian monk Gregor Mendel (1822-84).

> Mendel, as historians of science recently have pointed out, was not the lonely originator of modern population genetics 'whose only associates lived in the next century', but in a historizised view Mendel should be seen as part of a tradition founded by the plant geographer and pre-Darwinian evolutionist Franz Unger, who was Mendel's teacher at Vienna University, and who had himself been influenced by A. v. Humboldt and by idealist morphology.[475]

To de Vries the rediscovered laws provided evidence for the existence of sudden changes in species (which he named 'mutations'). Although this has not necessarily to be interpreted along the lines of romantic biology, in de Vries' view this also provides support at least for a saltationistic speciation as opposed to Darwin's gradual one. The

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[472] P. J. Bowler, *Evolution: The History of an Idea* (1984), p. 278-282. G. B. Shaw, *Back to Methuselah* (1921/1990), see the Introduction; but see also: P. J. Bowler, *The Non-Darwinian Revolution* (1988), pp. 152-173.

[473] See L. v. Bertalanffy, *Kritische Theorie der Formbildung* Berlin (1928), pp. 166 ff, quoted in J. H. Woodger, *Biological Principles: A Critical Study* (1929), p. 484.

[474] It is not possible for me to judge here whether saltationism at the beginning of the 20th century shared this essentialist belief.

[475] S. Gliboff, *Gregor Mendel and the Laws of Evolution* (1999).

English scientist who had coined the term 'genetics', also opposed Darwinism: William Bateson (1861-1926), after being influenced by de Vries, focused even more strongly than de Vries on evolution by mutation pressure. The first phase where Mendelism became influential runs from the 1900 to 1910 and is dominated by Vries, Bateson and Johannsen. The second phase of Mendelism beginning in 1910 was dominated by the Morgan school, focusing on more specific genetic questions.[476] However, even in the early times of the evolutionary synthesis e. g. the geneticist R. Goldschmidt and the palaeontologist O. H. Schindewolf (like most other German palaeontologists) supported saltationism. Today's palaeontological theory of punctuated equilibrium may in a way be seen as a revised form of saltationism[477].

Although the opposition against Darwinism was predominant till 1930, the different directions and disciplines were unable to build up *one* coherent synthesis. In 1929 the philosopher of science J. H. Woodger wrote: the "general theoretical results which have been reached by investigation along the lines of physiology, experimental morphology, genetics, cytology, and the older descriptive morphology are extremely difficult to harmonise with one another [...]."[478] He even described the basic biological principles of his time in terms of antitheses, like vitalism and mechanism, structure and function, organism and environment, preformation and epigenesis, teleology and causation, mind and body. He predicted a fundamental change in biology, which would incorporate all these aspects. And indeed another paradigm was really in the making, although Woodger would probably have regretted that not all these notions found entrance in this synthesis. The so-called evolutionary synthesis was at least mainly a revival of a moderated form of Darwinism. However, it is still difficult to decide if Darwinism had changed its conceptual hard core and assimilated other ideas, or if it had changed only its 'protective belt'. Here a middle position is held; a new subparadigm was born, which still is at least largely a Darwinian one, though it is in some respects less radically Darwinian than Weismann's pan-selectionism. Thus, if we look back, it seems adequate to state that the time between 1890 and 1930 was only a short 'eclipse of Darwinism', which then gained dominance again[479].

4.3 Evolutionary Synthesis

In 1943 Julian Huxley (1887-1975), grandson of Thomas Henry Huxley, pronounced in his book *Evolution, the Modern Synthesis* the birth of a unified, mainly Darwinian, biology. The basis of the so-called evolutionary synthesis was built in the 1920s and 1930s and its elaboration was largely finished in the 1940s and early 1950s.[480] It was a

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[476] The distinction in two Mendelian periods from: E. Mayr, *The Growth of Biological Thought* (1982), pp. 731 ff.

[477] There are differences as well, ➲ pp. 149 f..

[478] J. H. Woodger, *Biological Principles: A Critical Study* (1929), p. 12.

[479] The term 'eclipse of Darwinism' is coined by J. Huxley, and is the title of a book by Peter Bowler.

[480] W. B. Provine mentions that all participants of a conference on the history of the synthesis agreed that a theoretical consensus was met at this frame of time, *Epilogue* (1980), pp. 399. Still, especially in France there was a resistence to accepting the synthesis until at least well into the

synthesis of different theoretical approaches, as well as of different fields – which often correspond to different approaches.

In the following four subsections the main aspects of this impressive convergence of views and the main characteristic of the resulting paradigm will be elaborated. The influences on this synthesis *external* to biology are worked out later on. Here the *internal* history of the synthesis is treated. In the first and second section we will introduce the main contributiors and main tenets of the first and second phase of the evolutionary synthesis. In section three the main different features of this Darwinian paradigm, its focus on additional evolutionary – largely Darwinian – factors and its focus on the level of populations will be worked out. Finally it will be discussed whether advocates of this view were inclined to be more guarded in applying their approach towards man as well.

The synthesis generally was neither solely based on the developments in genetics[481] nor solely on the development of population thinking; it seems that both contributed to it.[482] Nevertheless the synthesis always has been far from being monolithic.[483]

I think, one might even challenge the often held assumption that the resulting evolutionary synthesis has itself in its different wings or phases been purely Darwinian.

On the one hand many proponents of the synthesis have quite clearly stated something like: "All known evolutionary rules can be explained by mutation and selection."[484]

On the other hand, it must firstly be acknowledged that population genetics was already a Mendelian-Darwinian synthesis (see below) and Darwinism had to some extent to give up its own emphasis on the continuity of variation and hereditary change. Secondly, as we will see, Darwin's exclusive focus on the individual organism was abandoned, and concepts like population, isolation and species were developed which, according to Mayr, were in Darwin's day still rather nebulous.[485] Thirdly, it has been argued that earlier developments in phylogenetic research, by proponents who did not yet see mutation and selection as the sole mechanisms of evolution, still paved the way for population genetics.[486] Fourthly – which in my opinion is of most importance –, in the later period of the synthesis some tenets such as Lerner's concept of genetic homeostasis, which is rooted in rather non-Darwinian traditions, had been

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1960s. C. Limoges, *A Second Glance at Evolutionary Biology in France* (1980), pp. 323, 327. See also the following discussion of the two phases of the evolutionary synthesis.

[481] W. B. Provine, *Genetics* (1980), pp. 51 f.

[482] E. Mayr, *Prologue* (1980), pp. 28-44, see also Mayr, 1982, pp. 550-570; 1991, pp. 132-140, or F. M. Wuketits, *Evolutionstheorien* (1995), pp. 59-65.

[483] Tensions could observed in e.g., E. Mayr, W. B. Provine (Eds.), *The Evolutionary Synthesis* (1980).

[484] B. Rensch, *Historical Development of the Present Synthetic Neo-Darwinism in Germany* (1980), p. 298; here quoting an article of his from 1943, p. 52. See also E. Mayr, *Growth of Biological Thought* (1982), p. 514.

[485] ➲ pp. 110 f., 130 f. See also E. Mayr, *Animal Species and Evolution* (1963), p. 2.

[486] P. Bowler, *Life's Splendid Drama* (1996), pp. 39, 442-443.

incorporated into the synthesis.[487] Sometimes, for example, Waddington, who is normally contrasted to Darwinism, has also been declared to have contributed to the synthesis.[488]

What we call Darwinism is in any case a function of our definition and our own theoretical position. I personally think that the notion *Darwinism*, especially as it expands to other fields, is used too broadly. Whether this also applies to the synthesis cannot be discussed here. A more precise definition of Darwinism would be needed (➲ p. 358). For the time being, according to our working definition (➲ p. 102) and because the synthesis no doubt owes much to the concept of natural selection,[489] here we will treat the synthesis simply as another *Darwinian* paradigm.

In this treatment of the evolutionary synthesis I shall try to give reason to the hypothesis that the evolutionary synthesis was logically and historically achieved in two relatively distinct phases.[490] Although the term 'phase' should indeed indicate a logical succession, I have to concede that they actually existed in parallel for a while and could in this respect also be seen as the two wings of the synthesis. Still, the second wing – at least for a while – gained predominance.

E. Mayr normally used the term 'evolutionary synthesis' to refer only to the proponents of the second phase,[491] whereas other authors have emphasised the contributions of the first phase[492]. Historical positions might reflect biological viewpoints, that is, which wing of the synthesis an author belongs to. In history and philosophy of science Mayr's viewpoint – possibly also because of his own contributions to these fields – seems to prevail. By arguing that the synthesis has taken place in two phases, one apprehends a certain unity of both views, the necessity of early contributions and – largely acknowledged and only recently challenged – the superiority of the second phase of the evolutionary synthesis.

a) First Phase – Synthesis of Genetics and Population Statistics

Early Darwinism had the problem of explaining how there could be enough variability on which natural selection could work. In particular since Weismann had refuted the concept that variance is sustained by properties aquired during an organism's lifetime this problem became pressing and even challenged Darwinism in general. Natural selection would quickly weed out any variance.

Moreover, Darwin and most of his followers advocated blending inheritance, which even without any selection pressure, would in each successive generation lead

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[487] G. E. Allen instead destinguishes mechanistic, holistic and dialectical materialism *within* Darwinism, *The Several faces of Darwin* (1983), for a discussion of Lerner see pp. 92 f.

[488] E. Mayr, *Animal Species and Evolution* (1963), p. 6.

[489] *Ibid,* p. 2.

[490] Similar e.g., P. Bowler, *Evolution.* (1984), pp. 290-300.

[491] E. Mayr often repeats his distinction and contrasts the synthesis with Fisherism, *One Long Argument* (1991), p. 144. But sometimes he concedes that his distinction is somewhat arbitrary, *Ibid,* p. 134. Also C. H. Waddington focused on the importance of the second phase, *Epigenetics and Evolution* (1953), quoted in W. Provine, *Epilogue* (1980), pp. 402, 411.

[492] See: W. B. Provine, *Epilogue* (1980), pp. 401-402.

to a diminution of individual differences. The variance of populations would fade and would quickly tend to centre closely around the mean.[493]

The saltationistic school, at odds with Darwinism, was continued after 1910 predominantly by the late Mendelian Thomas Hunt Morgan (1866-1945), who had founded the work on *Drosophila*[494] in the famous fly room at Columbia University. Morgan and his school stressed the independence of individual genes and discontinuous variation. The discontinuity given by Mendel's laws seemed inconsistent with a gradualist Darwinian view.

Only the evolutionary synthesis was able to highjack this concept and integrate it as a central building stone for the still – largely – Darwinian framework, which at that point could explain how variability is sustained on a higher level, the level of population.

The core of this synthesis was the development of *population genetics*, including both the genetic level and the level of statistical analysis of the population. In this context, the term *population* is defined as all individual organisms which could freely interbreed with each other. The sum of all genes of such a population is called *gene-pool. Alleles* are different genes at the same locus (on the same or on corresponding chromosomes).

The Hardy-Weinberg equilibrium is the equation which builds the heart of population genetics. This 'law or principle'[495] had already been formulated in 1908 by the British mathematician Godfrey H. Hardy and the German physician Wilhelm Weinberg independently. It says that, if mating between individuals occurs at random and there are no external influences, the relative frequencies of two alleles would remain constant in a gene pool. Hence, the variance of a population does not fade without any external cause, as would have been the case in models of blending inheritance.

> Given a diploid genetic system, where chromosomes correspond to each other in pairs. Provided that for the discussed gene locus (or more exactly, for the two corresponding loci), there are only two different kinds of genes (=alleles) present in the population. These possible gene expressions, A and a, have a relative frequency in the gene pool, p and q. In this two allele case the equation $p + q = 1$ is valid by the definition of relative frequencies.
>
> During (sexual) reproduction two reproductive cells, which both have a reduced (haploid) set of chromosomes, unite. This results again in a cell with a proper set of pairs of chromosomes (diploid set). If a random mixing of alleles is taken for granted (➲ below) than the probability that on the corresponding loci is one of the two alleles *A* or *a* corresponds to their relative frequencies *p* and *q* in the gene-pool.
>
> Hence, the allele combinations *AA* should have the relative frequency $p \times p = p^2$, *Aa* should have the relative frequency $(p \times q) + (q \times p) = 2pq$, and *aa* finally should have the relative frequency $q \times q = q^2$. If we now check the new overall relative frequency of the

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[493] This view resembles Mayr's position. But see also P. Bowler, *The Non-Darwinian Revolution* (1988), pp. 91 f., 106.

[494] *Drosophila* has become for a long time the paradigmatic experimental object of population geneticists. The mathematical approach and the standardised laboratory experiments have been criticised as *Drosophilosophy-obsession* (notion of the biologist E. B. Ford). Mentioned by: M. Midgley, *Beast and Man* (1978/1995), p. 135.

[495] A dispute has taken place as to whether the Hardy-Weinberg equilibrium is a law of nature or a principle. The main opponents were M. Ruse and D. Hull. See: E. Lloyd, *The Structure and Confirmation of Evolutionary Theory* (1994), p. 5.

> alleles p and q in the gene pool, we have to sum up the relative frequencies of the alleles of the different combinations: $p^2 + 2pq + q^2 = (p + q)^2$. Because of the definition of relative frequencies $(p + q)^2$ is equal to 1 which is consistent with the definition that $p + q$ equals 1.
>
> In conclusion, the relative frequency of two alleles in a gene pool could remain constant. The resulting combinations on the two chromosomes of the organisms is, as we have seen, distributed according to a binomial distribution. The Hardy-Weinberg equilibrium could be generalised also for cases of n alleles and m chromosomes and is distributed as a multinomial distribution: $(p + q + \ldots + n)^m$.[496]

The Hardy-Weinberg equilibrium is valid only under the precondition that there is an 'ideal population'. A population is ideal if it is panmictic (all reproductive combinations of the same individuals have the same possibility); if it has an endless (or at least sufficient high) number of organisms; and if it is not exposed to either mutation, selection, migration, or inner isolation. The artificial character of these assumptions is at least partly intended, because the equilibrium provides a yardstick against which evolutionary change, e. g. the strength of selection, could be measured.

> Still, such a measurement is of course only valid when we do know from other considerations that all other preconditions are fulfilled. Otherwise the different influences would be attributed to the measured factor.

The biologists *Ronald A. Fisher* (1890-1962), also an important contributor also to modern statistics, and *John Burdon Sanderson Haldane* (1892-1964) made far reaching mathematical contributions, based on this framework. Both believed that natural selection is the predominant force which causes changes in the above equilibrium and thus leads to gradual evolution.

Philosophically this perspective seems to me to be a synthesis of two extreme aspects, the macroscopic and the microscopic aspect. On the one hand, this view introduced the macro-level of a whole population (or better: 'gene pool') into the Darwinian research tradition. On the other hand, they have combined this with a genetic perspective. Fitness in this view becomes defined by the changes of frequencies of a given gene at a given locus compared with its alternative genes – its alleles – on that locus in a given population. Hence, fitness is now in one aspect a property of a single gene, in another only definable in relation to a distribution of alleles in its population.

Fisher, in particular, did not treat the phenotypic individual organism or visible population, but arrays of genes.[497] Fisher largely based his work on the three assumptions which were later disputed: the exclusive importance of the genotype, the neglect of interactions of individual genes and the concept of complete random recombinations.

b) Second Phase – Population Structure and Macroscopic Mechanisms

The second step of the evolutionary synthesis is mainly characterised by the conceptual introduction of population structure into the theoretical mathematical

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[496] For example: D. J. Futuyma, *Evolutionsbiologie* (1986/1990), pp. 95 f. H. Knodel, *Linder Biologie* (1948/1988), p. 315.

[497] D. J. Depew, B. Weber, *Darwinism Evolving* (1995), p. 246.

models, which had been based on the assumption of total panmictic 'ideal' populations. This was paralleled with a stronger focus on the actual situation in which naturalists find populations, and by an introduction of additional evolutionary factors.

Proponents of the second step of the evolutionary synthesis, in particular Mayr, have often emphasised that nothing in the evolutionary writings of Fisher and Haldane could explain the process of multiplication of species.[498]

We will now outline the contributions of only three of the main figures of the second phase of the evolutionary synthesis, before we give a more systematic account in the following section.[499]

The American geneticist *Sewall Wright* (1889-1988), who together with Fisher and Haldane was one of the founding fathers of mathematical population genetics, took already the real, complex structure of what he called "adaptive landscape"[500] into account. Wright was the first, who focused more on the concepts of gene-interactions[501], of subpopulations and of 'interdemic' selection. In very small subpopulations it is more probable that a different subset of genes becomes fixed than in the underlying distribution of the whole population, independent from any selection pressure. In terms of the probability theory this is an obvious effect and had already been recognised by Fisher, who thought it a deviation from the main process of natural selection. Wright on the contrary regarded this process as an essential part of evolution and called it 'genetic drift'. The fixation of a combination of genes in small populations by chance and not by natural selection, is an additional (we might say macroscopic) way in which variance, now not *within* but *between* subpopulations, is sustained.

Till then this had continued to be a problem. Although the Hardy-Weinberg equilibrium gave an answer to the question why the variation will not diminish without selection pressure, it was still difficult to explain how variation can be maintained if there *is* selection pressure. In this situation, in his 'theory of shifting balance' Wright stated that genetic drift plays a central role in producing variance between small, interbreeding subpopulations, which are partly isolated from the total population.

The Russian geneticist *Theodosius Dobzhansky* (1900-75), who had emigrated to the USA, but was already influenced by a Russian school of genetics based around Sergei Chetverikov, followed Wright's argument that drift plays an important role in sustaining variation. Even more than Wright, he emphasized in his book *Genetics and the Origin of Species* (1937) the adaptation of whole populations, and that a gene's fitness is always context related.[502] Presumably because of this Mayr has praised him – and

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[498] E. Mayr, *One Long Argument* (1991), p. 133. Also e.g., R. Lewontin, *Theoretical Population Genetics in the Evolutionary Synthesis* (1980), p. 61.

[499] I have to neglect some founders of the synthesis, like e. g. the zoologist Bernhard Rensch and George Gaylord Simpson, who with their book *Tempo and Mode in Evolution* (1944) brought palaeontology into the new synthesis.

[500] On this metaphor: M. Ruse, *Are Pictures Really Necessary? The Case of Sewall Wright's 'Adaptive Landscapes'* (1996).

[501] R. C. Lewontin, *Theoretical Population Genetics in the Evolutionary Synthesis* (1980), p. 61. But ➲ footnotes 502, 503.

[502] Th. Dobzhansky, *Genetics and the Origin of Species* (1951), p. 254.

not Wright – as the founding father of the synthesis.[503] (Wright, although mathematically also concerned with structured populations, did not yet focus so much on the actual populations observed by the naturalists. In this sense he can be located somewhere between the first and second phase of the evolutionary synthesis.)

In Dobzhansky's model of 'balancing selection' (partly opposed to Wright's 'shifting balance') he proposed that the variation within heterozygotes is an adaptation which allows populations to ride over large maladaptive valleys. In this emphasis, he mirrors his former teacher Sergei S. Chetverikov who came to the conclusion that, "a species, like a sponge, soaks up heterozygous mutations, while remaining from first to last externally (phenotypically) homozygous"[504]. I think, that the concept of accumulated variability, which is adaptive, not in the short but in the long run, foreshadowed the later anti-selectionist claim of genetic neutralism (Kimura).[505]

Mayr (1904-2005) worked in a similar framework but in *Systematics and the Origin of Species* (1942) stressed the actual circumstances in which populations and individual organisms are found by the naturalist. Among the proponents of the evolutionary synthesis it was mainly he who highlighted the phenotypic side of the evolutionary process. This, I suppose, is due to a radicalisation of the concept of the context relatedness of genes, already emphasised in Dobzhansky's work. Mayr strongly advocates that genes "not only act but interact", that there is a "harmoniously integrated" "unity of the genotype" and hence opposed what he has called beanbag genetics.[506] Pushed to its extreme it does not make sense any more to look at single genes or gene pools, but phenotypic individuals and populations or species.[507] According to Mayr genes mutate, organisms are selected and species evolve.

Mayr focused on the concept of allopatric speciation and geographical isolation. Like other proponents of both phases of the synthesis he used a definition of species and populations based on reproduction (the so-called *biological* concept of species), but by these conceptions he focused on phenotypic conditions which are, according to him, important, if not necessary, for speciation. He also established the recognition of a similar chance effect like genetic drift, namely the *founder effect* (1954). Genetic drift focuses on the fact that in small populations, elimination of individuals is largely due to chance and not to natural selection. The founder effect states the same process not in the case of existent small groups, but in the case of the founding of a new group; for example a pregnant bird which starts a settlement on a remote island.[508] Corresponding to his focus on the phenotypic aspects Mayr uses a term for this mechanism denoting the phenotypic level.

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[503] E. Mayr, *The Growth of Biological Thought* (1982), p. 568.

[504] S. S. Chetverikov, *On Certain Aspects of the Evolutionary Process* (1926, engl. translation, 1961), p. 105, p. 178, quoted in E. Mayr, *The Growth of Biological Thought* (1982), p. 557.

[505] The matter is actually more complicated. Kimura was vigorously criticised by R. C. Lewontin, who because of his emphasis on allelic polimorphism is often counted amoung the main defenders of Dobzhansky's legacy.

[506] E. Mayr, *Animal Species and Evolution* (1963), Chapter 10, pp. 263 f., 295.

[507] E.g., E. Mayr, *Evolution und die Vielfalt des Lebens* (1978), p. 242.

[508] See E. Mayr, *Growth of Evolutionary Thought* (1982), pp. 602 f.

c) Evolutionary Factors and the Importance of Populations

The evolutionary synthesis, although most of its proponents were self-proclaimed Darwinians, – especially after its second phase – had properties which had been missing in or even contradicted Darwin's and Weismann's Darwinism. Although to the proponents of the evolutionary synthesis *natural selection* and also individual natural selection was still the main driving force of evolution, they enriched evolutionary theory with several *additional factors*. After this has been shown, the stress of the synthesis on the population level will be worked out.

Now, *mutations* were regarded as source of *new* variability, and in a way as an additional factor. The Hardy-Weinberg equilibrium had explained only the stability of a given variance if there are no external influences, especially no selection.

Mutations were now understood as sudden random changes in the nucleotide sequence of the DNA. Mutations provide for the emergence of entirely new genes, a concept necessary for evolutionary change above the change of mere gene-frequencies in a gene pool. Mutations exist on all 'levels' of the genome, from single base pairs of a gene (point mutations) to full chromosomes.

The concept of mutation was originally reintroduced to biology by de Vries, who – although natural selection played a role in his theory – was rather a Mendelian.[509] Mendelians, like Bateson favoured a theory of mutation pressure. Correspondingly this conception was originally rather allied with anti-Darwinian orthogenetic theories. But Mendelism at the same time also undermined the analogy of evolution and growth, even more than Darwin did, and separated genetics from embryology.[510] Hence the evolutionary synthesis was able to transform the concept of mutation into a process of blind chance[511], fitting neatly into a Darwinian frame of mind, since Darwin had also sometimes written of chance variation at the individual level.[512]

Although this factor was new, one may hence argue that in principle this – transformed – concept of mutation modernised but did not add much to the theory.

> Today the notion of a total chance character of mutation central to population genetics comes under pressure from genetics. In genetics one speaks of so-called *mutation genes* making certain mutations more probable than others. I personally think, it is largely up to our interpretation, to argue whether on an imagined continuum between Darwinism and Lamarckism, we move by this insight more towards Lamarckism again.[513]

Moreover, the evolutionary synthesis in its second phase was mainly inspired by contributions of the naturalists, which also statistically led to slight change in focus. The crucial point is the subdivision of the 'ideal' population in many sub-populations. This macrobiological concept has resulted in several new evolutionary factors:

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[509] See: G. E. Allen, *The Evolutionary Synthesis: Morgan and Natural Selection Revisited* (1980), p. 366 f.

[510] P. Bowler, *The Non-Darwinian Revolution* (1988), pp. 106, 114, 117-120, 123-125.

[511] See: F. Wuketits, *Evolutionstheorien* (1995), p. 71.

[512] Still, the *word* 'mutation', which could be found seven times in the *Origin of Species*, there just means change.

[513] ➲ pp. 146 f, and pp. 363 ff.

- *Isolation* (*reproductive)* is regarded as necessary precondition for the development of sub-populations, and thus as a prerequisite for speciation.
- *Migration* between partly isolated subpopulations increases the regional variability.
- *Genetic drift* takes place among small populations, where mere chance can play a role in fixing certain gene-combinations.
- The *founder effect* similarly states that the sample of genes which a founder of a new population contributes influences the gene-distribution considerably. This effect is also largely due to chance and is understood as directionally blind.

According to the Evolutionary Synthesis, all these factors, adding to the mechanism of individual chance variation and elimination, in the first place play an important role in sustaining the necessary variability within the population as a whole, and, secondly, enable the change of gene distribution in a gene pool necessary for speciation. The acknowledgement of macrobiological preconditions for speciation also led to the distinction of cladogenesis, branching, and anagenesis, phyletic evolution[514].

Despite the novelty of the factors, they may be seen as pointing to the concept of natural selection, except on the level of populations. Natural selection, in its broad sense, is normally regarded as composed out of two sub-processes: chance variation and elimination of the unfit.[515] In my opinion the evolutionary synthesis seems to have introduced this process on the level of populations as well. The factors of *reproductive isolation, genetic drift* and *founder effect* are all mainly regarded as chance processes which increase the variance between sub-populations. *Migration* and other forms of gene flux increase the variability within subpopulations. This parallel is not always made explicit; but, for example, Mayr – in disagreement with J. Huxley – has argued: "Every new species is an ecological experiment, an attempt to occupy a new niche [...], species, in the sense of evolution, are quite comparable to mutations."[516]

But under closer scrutiny that analogy might be too simplifying, because these mechanisms also change the working of phylic evolution. However, I think one can conclude that despite the many concrete mechanisms the evolutionary synthesis was mostly perceived as only introducing a slight causal pluralism, which in its mechanism still essentially resembles Darwinism. Linked to these new mechanisms is the philosophical innovation of the introduction of the importance of the population level.

> A side-effect of the application of the concept of natural selection (in the broad sense) to the population level is that individual organisms are not necessarily highly adapted. If organisms act for the good of the species they do not necessarily act for their own good. Hence the

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[514] E.g., Th. Dobzhansky, *Mankind Evolving* (1962), p. 220. R. Lewontin, *Theoretical Population Genetics in the Evolutionary Synthesis* (1980), p. 61. This distinction refers to the distinction between micro- and macroevolution, which was earlier proposed by de Vries, and is, I think, not compatable to Darwin's originally more individualistic approach.Hence this view has sometimes be regarded to be at odds with the essentially Darwinian programm of the evolutionary synthesis, e.g., G. Masuch, *Zum gegenwärtigen Stand der Diskussion* (1987), pp. 50 f.

[515] ➲ working definition of natural selection on p. 102.

[516] E. Mayr, *Animal Species and Evolution* (1963), p. 621; *Evolution und die Vielfalt des Lebens* (1978), p. 241.

population level of adaptation may also have reduced the strong adaptionism on the level of individual organisms.

Correspondingly, *populations* (groups of interbreeding organisms), or gene pools are at the very centre of evolutionary biology: "Evolution is a change in the genetic composition of populations"[517]

Nearly all advocates of the evolutionary synthesis have defined species in terms of reproduction, i. e. the so-called *'biological' concept of species*.[518] Strictly speaking a definition, fitting to the second phase of the evolutionary synthesis, has to mention partly isolated sub-populations. Hence, in textbooks one will usually find a definition like: a species is "a group of interbreeding natural populations, which are reproductively isolated from other such groups"[519].

Only G. G. Simpson slightly differs from the other main proponents of the synthesis in this respect and has defined a species generally differently. "An evolutionary species is a lineage (an ancestral-descendent sequence of populations) evolving separately from others and with its own unitary evolutionary role and tendencies."[520]

This predominant definition of species is linked to *species realism*.[521] "The Species is the real unit of evolution, it is this changing entity, which specialises and adapts"[522]. The species nominalist Darwin had largely assumed that species are only convenient notions, which artificially describe a close similarity between individual organisms.[523] According to the synthesis species and gene pools, unlike individual organisms and single genes, are long lasting. A precondition for genetic recombination in sexually reproducing organisms is the existence of a common gene pool. Based on the outlined evolutionary factors the units of evolution (not necessarily of selection) are structured populations or gene pools. Dobzhansky goes farthest when he speaks of the 'organism-like integration' of interbreeding populations.[524]

This realism of species or, better, of structured populations differs of course from the classical typological species realism.[525] It is not due to what Mayr calls a typological concept, a pre-existing form, which is given externally to the species itself,[526] but it is based on a populational concept, a concept of a common gene pool of a species, a pool of information, a common fountain of youth, from which all organisms and sub-populations derive from and to which all reproducing organisms con-

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[517] Th. Dobzhansky, *Genetics and the Origin of Species* (1951), p. 16.

[518] *Ibid,* p. 262-263.

[519] G. Vogel, H. Angermann, *Dtv-Atlas der Biologie* (1990), p. 495 (translation by the author).

[520] G. G. Simpson, *Principles of Animal Taxonomy* (1961), p. 153, quoted in E. Mayr, *One Long Argument* (1991), p. 28.

[521] See Th. Dobzhansky, *Genetics and the Origin of Species* (1951), p. 256. E. Mayr, *Animal Species and Evolution* (1963), pp. 422-423.

[522] E. Mayr, *Evolution und die Vielfalt des Lebens* (1978), p. 241 (translation by the author).

[523] ➲ pp. 110 f. Darwin's approach is contrasted with that of the synthesis for example by E. Mayr, *Animal Species and Evolution* (1963), pp. 13-14, 29.

[524] Th. Dobzhansky, *Genetics and the Origin of Species* (1951), p. 15.

[525] E. Mayr, *Animal Species and Evolution* (1963), Chapter 2-4, also Chapter 14.

[526] Confer my concept of exformation and external memory, which tries additionally to reestablish some aspects of this historical conception; ➲ pp. 311f., 316 f.

tribute. According to the synthesis populations and species are real, but at the same time they are the only real taxa; all other higher taxa, like genera and so on, are in principle nothing but useful artificial conventions.

This population realism is accompanied by *gene realism and only partly* by *a nominalistic attitude towards organisms*. Populations are understood as arrays of genes which mix freely. This assumption, emphasised in the first period of the evolutionary synthesis, has never been completely superseded. A panmictic population is a precondition for most of the statistical tools of population genetics and is linked to the notion of independent and not contextually defined genes. In the second phase of the evolutionary synthesis this concept has statistically been dismissed only in regard to the relation between different sub-populations, not – as far as I can judge – *within* sub-populations.

Despite this, it was an explicit conviction of the second phase of the evolutionary synthesis, especially during the years between 1950 and 1965, that there were gene interactions.[527] In the wake of Dobzhansky, absolute fitness values of single genes were denied, and it was emphasised that fitness of genes depends strongly on the genetic and the environmental milieu.[528] Mayr in particular advocated the importance of gene interactions and quite clearly arrived at a realist position concerning individual organisms, by simultaneously dismissing the focus on population genetics. Apart from him, the general trend of the statistical approach led, in the second phase of the synthesis as well, to what Mayr called "bean-bag genetics"[529], at least *within* sub-populations.[530]

The emphasis on a gene-pool, with the concomitant assumption of largely independent genes, led – I presume – to the overwhelming *disapproval of sexual selection* by most proponents of the Evolutionary Synthesis. Any concept of sexual selection violates the assumption of panmixia. Correspondingly, many advocates of the synthesis, in particular Julian Huxley, campaigned against the concept of sexual selection.[531]

But, as already has become apparent, the evolutionary synthesis was and is *not a monolithic block*. Although Mayr, for example, emphasises the whole individual organism as a real entity and as a unit on which selection apparently works, still to him the 'unit of evolution' is the population. Nonetheless, E. Mayr has acknowledged populations as possible units of selection.[532] Other followers of the synthesis focus even more strongly on the population as the unit of selection.[533] S. Wright, for

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[527] R. Lewontin, *Theoretical Population Genetics in the Evolutionary Synthesis* (1980). R. Lewontin, *Gene, Organism, Environment* (1983), p. 277.

[528] E. Mayr, *The Growth of Biological Thought* (1982), p. 592.

[529] E. Mayr, *Where are We?* (1959), quoted in E. Mayr, *The Growth of Biological Thought* (1982), pp. 558. But see also a reply of J. B. S. Haldane, *A defence of beanbag genetics* (1964).

[530] In discussing models of group selection M. J. Wade makes the criticism that the underestimation of interaction of genes in the mainly genotypic models of population genetics biases the results, *A Critical Review of the Models of Group Selection* (1978).

[531] S. J. Frankel, *The Eclipse of Sexual Selection Theory* (1994).

[532] E. Mayr, *What Evolution Is* (2001), p. 308. However, this might be due to his group selectionist interpretation of kin selection and reciprocial altruism, cf. *One Long Argument*, (1991), p. 157.

[533] W. Wieser, *Energetische und soziale Aspekte der Evolution* (1989), p. 101.

example, states that there is also selection on the level of demes[534]. The importance and function of different levels of selection had already been a source of dispute to advocates of the Evolutionary Synthesis. However, it was generally agreed that events on the population level were somehow crucial to the formation of new species.[535]

> The sub-paradigm of gene-Darwinism later on started to argue against the importance of the population level in general and group selection in particular (➲ pp. 33, 123, 191).

The focus on populations goes along with the concept that entities, mainly populations, could have properties which their components did not have. This *emergentist belief* is for example expressed by Dobzhansky: "The rules governing the genetic structure of a population are, nevertheless, distinct from those which govern the genetics of the individuals, just as rules from sociology are distinct from physiological ones, although the former are in the last analysis integrated systems of the latter."[536] This emergentist belief is advocated, although the Evolutionary Synthesis – as we have seen previously – is still largely Darwinian in regard to the processes employed and indeed emphasises chance production of variation and differential elimination.

Still, the emergentist attitude and the changed general conceptualisation of evolution affected in which way this school applied their biological theory to culture.

d) Disengagement from Ideological Programmes?

In the literature on the attitude of the Evolutionary Synthesis towards culture one could find the position that it was accompanied by a disengagement from ideological programmes.[537]

This is not the case in regard of the first phase of the Evolutionary Synthesis, which by many authors is designated as Fisherism. Fisher was in fact a particularly ardent supporter of positive eugenics, which he explicitly regarded as Nietzschean in character.[538]

Only with the second phase of the synthesis, especially with the works of Dobzhansky, Mayr and Simpson, a relative ideological disengagement seems to have taken place.

I think, this ideological disengagement in the second phase of the evolutionary synthesis is, despite important reservations, due to two aspects of the Evolutionary Synthesis: (1) The synthetic evolutionary theory in its second phase advocated some properties which make an application to man less harmful. (2) The evolutionary synthesis gave reason to be cautious in any direct application, and to acknowledge the entire dissimilarity of biological evolution and cultural development.

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[534] S. Wright, *Evolution in Mendelian Populations* (1931).

[535] E.g., D. Young, *The Discovery of Evolution* (1992), p. 218.

[536] Th. Dobzhansky, *Genetics and the Origin of Species* (1951), p. 15.

[537] E.g., D. J. Depew, B. Weber, *Darwinism Evolving* (1995), p. 13.

[538] D. J. Depew, B. Weber, *Darwinism Evolving* (1995), pp. 244 ff. These authors in accordance with Mayr only call the second phase 'evolutionary synthesis'.

(1) The final Evolutionary Synthesis did not support a panselectionist view. New evolutionary factors, besides natural selection working on the level of the organism came into play. Factors working on the macro-level of populations, like the chance processes of genetic drift, and the founder effect, show that besides natural selection also chance plays a role in the moulding of organisms. This resulted in an abolishment of a radical adaptionism; not all aspects of an organism are naturally adaptive.

Secondly, in its later phase, proponents of the evolutionary synthesis largely accepted a certain degree of context relatedness with regard to a gene. A gene which might be maladaptive in one population could in a successive gene-pool with changed gene distributions or in a different environment suddenly turn out to be adaptive again.

Thirdly, the recognition of the positive importance of variation in the evolutionary synthesis contributed something to the abolishment of a simplifying programme of eugenics. This was mainly due to Dobzhansky, who had imported this view from Chetverikov's school of genetics, and who strongly believed in democratic plurality. The structuredness of a population supports variation, which on the long run is itself adaptive.

Last but not least, the focus on the population level and the possibility of group selection might have weakened the 'Malthusian' character, social-Darwinism had hitherto had.[539] The focus on species or on populations was also predominant in classical ethology and even today there are influential proponents of this school like I. Eibl-Eibesfeldt, who emphasises group selection at least as far as early humans are concerned – also giving a basis for truly altruistic behaviour.[540]

> The known primatologists Jane Goodall and Frans de Waal in my opinion also belong to this paradigm. They did not already theoretically assume unrestrained and ruthless competition in groups of animals and would not easily reduce primate behaviour to simple gene-egoism. Although their approach might be regarded as rather a descriptive one, their results seem to me to fit rather into the explanatory framework of the evolutionary synthesis than into the framework of gene-Darwinism.

But there had been also ethologists concerning whom it would be wrong to generalise about the concept of ideological disengagement. In particular, the inglorious role of one of its founders should at least be mentioned. But the role of the Nobel laureate Konrad Lorenz in the time of Nazism in Germany can be opposed to the exemplary role of the co-founder of ethology Niko Tinbergen.

> There are many important questions, which could not be treated here at length: How did evolutionary theory, especially the evolutionary synthesis, influence Nazism, with its focus on racism? Which other aspects led to the blunt racist ideology of 'blood and territory (*Blut und Boden*)'? What was the theoretical difference of most of the founding fathers of the today still actual second phase of the synthesis and the Nazi-biologist in Germany (and other parts of the world)?

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[539] Here Malthus' emphasis on population growth and scarcity of recourses in combination with his general support for individual laisse-faire economics is meant. For a closer discussion of such a usage ➲ pp. 173 f.

[540] I. Eibl-Eibesfeldt, *Die Biologie des menschlichen Verhaltens* (1984), p. 131. (Eibl-Eibesfeldt on the other hand also combines this with results of the gene-Darwinian view, and in a way already takes a multi-level-viewpoint.)

Proponents of classical ethology, like K. Lorenz and N. Tinbergen, introduced the focus on populations of the Evolutionary Synthesis into the biological study of behaviour of animals and humans. By this they indeed made the study of instinctive behaviour in animals and man popular again. Lorenz was accused because of this focus on instincts and the 'natural' aggression of humans.[541]

Still Lorenz – based on the focus on the species – could also argue, that there is still something like 'species-preserving purposefulness' (*arterhaltende Zweckmäßigkeit*) of instinctive behaviour, like the killing inhibition of wolfs and dogs[542]. This at least in principle left some room for something like a basis for an altruistic behaviour, at least within a species. M. Midgley in the last decades has pointed out that this allows a much more positive approach to human biology than gene-Darwinism (➲ p. 46). Even Dawkins himself had called the ethology founded by Lorenz 'old benevolent regime'.

Despite this it has to be acknowledged that Lorenz, indeed had been involved in the racist research politics of the Nazis. It is a dispute, how far Lorenz' involvement into 'racial hygienics' had gone, but some involvement took place. The Dutch zoologist Tinbergen, who had strongly opposed the Nazis, after the war helped to rehabilitate Lorenz. However, many biologists especially in Germany, but also in many other countries have had advocated racism and Social Darwinism.

What role did biology have in this catastrophe? Neo-Darwinian explanations, according to Rensch, already prevailed in German biology textbooks between 1912 and 1945. Nevertheless, it was only slowly that accompanying sceptical remarks and defenders of different views were overcome.[543] According to Mayr, selectionist thinking began to spread in Germany not so much in the 1920s but mostly in the 1930s.[544] A proper treatment of biology in the time of Nazism would have to answer whether the involved biologists belonged to the first or to second step of the Evolutionary Synthesis, and in how far their views differed from both of these theories.[545]

Also the – in my view originally positive – force of German idealism and romanticism with its urge for unification of knowledge in a perverted way seems to have played a role, as it was combined with neo-Darwinism. If one wants to discuss this topic in depts, one needs to consider the position held by the British idealist Muirhead in regard of World War I, advocating that not Kant and Hegel, but the abandonment of these views were responsible for the highly aggressive attitude of the Germans at that time.[546] One may argue that both materialism and Darwinism may have contributed to the moral decay, and may indirectly have their share in the rise of Nazism.[547] But this topic is far too complicated and too important for any simplifying treatment: Not only vitalists like H. Driesch, but also Darwinians of a similar brand as Lorenz, like Tinbergen, opposed Nazism.

Apart from these reservations, I think it overall still appears to be correct that the new aspects of the *second* phase of the evolutionary synthesis, at least in Britain and the

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[541] M. F. Ashley Montagu (Ed.), *Mensch und Aggression* (1968/1969/1974).

[542] K. Lorenz, *On Aggression* (1963/1966/1967), pp. 104 f., 206-207.

[543] B. Rensch, *Historical Development of the Present Synthetic Neo-Darwinism in Germany* (1980), pp. 285 f.

[544] E. Mayr, *Germany [and the Evolutionary Synthesis]*. In: Mayr, E., Provine, W. B. (Eds.), *The Evolutonary Synthesis* (1980), pp. 281-283. See also P. Bowler, *The Non-Darwinian Revolution* (1988), pp. 123, 125.

[545] U. Deichmann, *Biologist under Hitler* (1996), pp. 179-205. An account asserting continuity in K. Lorenz views before and after World War II is provided by Th. J. Kalikow, *Konrad Lorenz's Ethological Theory: Explanation and Ideology, 1938-1943* (1983).

[546] See: S. M. d. Otter, *British Idealism and Social Explanation* (1996), p. 32.

[547] R. Nachtwey, *Der Irrweg des Darwinismus* (1959), Chapters 1, 6, 7, see also Chapter 8.

United States, have to some degree mitigated the social implication of the revival of biological neo-Darwinism.

(2) The other aspect of the ideological disengagement of the proponents of the evolutionary synthesis was a critique of directly drawing conclusions from the biological evolution to cultural development.

For example, J. Huxley, although writing much not only about evolution but also about ethics, finally rejected any *simple* analogy from biological evolution: "The human situation is so different from the biological, that it may prove best to abandon the attempt to apply concepts like natural selection to modern human affairs."[548] Such a rejection of a biologisation of human affairs was uttered by different authors of the synthesis, but could have many different reasons:

(a) It might be due to developments within sociology and psychology. In particular behaviourism, which in an increasingly moderate form dominated psychology till the 1960s or 1970s, opposed any reduction of psychological phenomena to specific biological instincts or drives.

> Of course behaviourism at the same time reduced inner phenomena to external behaviour. Moreover, paradoxically the trial and error process which behaviourism employs resembles a Darwinian process (➲ pp. 221 f.).

(b) For writings after the Second World War, the traumatic experiences of Holocaust, racism and millions and millions of war victims, has been a remaining memorial against all simplifying biologistic accounts.

(c) The Evolutionary Synthesis itself provided already within biology examples of emergentism. The dynamics of the macro-evolution is explained by some emergent properties (e. g. genetic shift) on the population level.[549] In spite of this, the proponents of the Evolutionary Synthesis have always emphasised that this is fully compatible with the micro-processes of evolution. More adequately, they tried to steer a middle course between reductionism and emergentism. For example, Mayr explicitly supported the notion of emergence, Simpson refered to it as compositional method and Lorenz (at least after the war) used the term 'fulguration' and refered to the ontological stratology of Nicolai Hartmann.[550] Dobzhansky, according to Francisco J. Ayala beheld that in man biological evolution has transcended itself into the realm of self-awareness and culture. Accordingly, although he apparently rejected fundamental beliefs of traditional religion, he was a "religious man".[551]

Corresponding with the general Newtonian background of Darwinism, some proponents still regarded human evolution to be governed by the same eternal set of

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[548] J. Huxley, *Introduction.* In *Evolution: A Modern Synthesis* (1963, 2nd), quoted in J. C. Greene, *Science, Ideology and World View* (1981), p. 165.

[549] ➲ footnote 536.

[550] E. Mayr, *The Growth of Biological Thought* (1982), pp. 63-64. K. Lorenz, *Die Rückseite des Spiegels: Versuch einer Naturgeschichte menschlichen Erkennens* (1973/1977), pp. 44-64. For my own treatment of emergentism ➲ pp. 245 ff.

[551] F. J. Ayala, *Theodosius Dobzhansky: The Man and the Scientist* (1976).

laws as animal evolution.[552] Accordingly their ideological disengagement has not been at all total. For example, Simpson applied the neo-Darwinian paradigm to man: "Man is the result of a purposeless and materialistic process that did not have him in mind. He was not planned."[553] Huxley, despite trying to extend the Darwinian concept of an apparently purposeless selection of random variations into a new general world-view, still saw a purpose in evolution.[554] Even Simpson, although he explicitly fought against any vitalistic and teleological explanations in evolutionary theory, came to the conclusion that man today is guided by 'interthinking' rather than by interbreeding,[555] and that finally the concept of the human uniqueness seems to have gained the upper hand: "The best human ethical standard must be relative and particular to man and is to be sought rather in the new evolution, peculiar to man, than in the old, universal to all organisms. The old evolution was and is essentially amoral. The new evolution involves knowledge, including the knowledge of good and evil."[556]

Most proponents of the final synthesis on the one hand similarly seem to have abandoned any strict biologistic stance. They had not the intention of reviving the crude message of social Darwinism. On the other hand they still claimed the relevance of natural selection for the understanding of the *homo sapiens*. For example, Dobzhansky argued against a biologistic stance proposed by Darlington, but at the same time also criticised the "staunchest nurture hypothesis" of the psychologist Watson and the radical culturalism of L. White.[557] It is typical for Dobzhansky, steering a middle course, that he advocated that the main *biological* trait of humanity is its plasticity and educability, and – although he allows some variance – this generally holds "in all classes and races of people, in short, in the species Homo sapiens."[558]

More work to substantiate the outlined position would be needed. But for the time being it can be concluded that most proponents of the later phase of the synthesis were, ideologically rather disengaged, at least in comparison with most early proponants of Social Darwinism.

4.4 'Sociobiology' as Gene-Darwinism – A New Synthesis?

'Sociobiology' as a special Darwinian sub-paradigm, not as a discipline, has already been characterised by a focus on selfish genes, and by a largely gene-deterministic approach towards culture and ethics (➲ pp. 1 ff.). Therefore here only a short *comparative historical* outline of its biological features will be given. Moreover, we will not treat this paradigm mainly in its own terms as a phenomenon, but use a more abstract descrip-

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[552] On the external history of Darwinism, ➲ pp. 160 f.

[553] G. G. Simpson, *The Meaning of Evolution* (1949), pp. 343-344, quoted in C. G. Greene, *Science, Ideology and World View* (1981), p. 171.

[554] P. Bowler, *Evolution* (1987), pp. 309-310.

[555] C. G. Greene, *Science, Ideology and World View* (1981), p. 172.

[556] G. G. Simpson, *The Meaning of Evolution* (1949), p. 281, quoted in C. J. Greene, *Science, Ideology and World View* (1981), p. 173.

[557] Th. Dobzhansky, *Man Evolving* (1962), pp. 75, 97, 99, 252, 320.

[558] *Ibid,* pp. 8, 100, 252, 320.

tion in order to grasp its paradigmatic core.[559] Only thereafter the more general, external historical background to this subparadigm will be analysed (➲ pp. 191 f.) and then the basic assumptions of this approach will be criticised (➲ pp. 243 f.).

The discussed subparadigm in this work has been called *gene-Darwinism* to distinguish it from other approaches in sociobiology and evolutionary theory. In this section am going in detail to characterise and define this sub-paradigm biologically by what I will call 'germ-line reductionism', 'gene-atomism' and (with certain a certain reservation) 'Darwinian process monism'.

The discussed sub-paradigm is clearly a Darwinian paradigm according to our working definition, since it focuses on natural selection as the main or only evolutionary mechanism, and this holds even more clearly than for the mentioned earlier sub-paradigms. The 'selfish gene' account of evolution[560] could be contrasted to the organism or genome centred theories of Darwin or Weismann as well as to the gene-pool or population centred conceptions of the evolutionary synthesis. But gene-Darwinism does not break with Darwinism, but it radicalises the more moderate views of Darwin, Weismann or the Evolutionary Synthesis – as well with regard to the evolutionary entities as to the evolutionary processes.

a) Germ-Line Reductionism

Dawkins radicalises Darwinism with an extreme interpretation of Weismann's concept of the continuity of the germ-plasm. This interpretation leads Dawkins to the conception of genes as immortal survivors in the battle of life and of phenotypes as largely epiphenomenal 'vehicles of genes' or 'gene machines'.[561]

Darwin, still partly a Lamarckian, favoured his theory of pangenesis, whereas later Weismann adopted a stricter neo-Darwinian approach. The Weismann barrier (➲ pp. 118), of course, has also been central to the proponents of the evolutionary synthesis. Hence the evolutionary synthesis – like gene-Darwinism – was in this respect a neo-Darwinian or Weismannian theory. However, the evolutionary synthesis, which accepted macroevolutionary factors, interpreted the Weismannian barrier in a way which we could evaluate either as being less radical or less clear than the interpretation of gene-Darwinism. Dawkins' interpretation of Weismann's barrier leads him to take a harsh nominalistic attitude towards the phenotypic side of

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[559] R. Dawkins emphasised the first aspect mentioned in the first sentence of the paragraph, whereas E. O. Wilson has emphasised the second one. Any differences from both aspects is here understoodas a deviation from the pure paradigm.

Proponents of sociobiology do not always regard themselves as proponents of this paradigm (➲ pp. 31). Even Dawkins wavered as to whether he regarded his approach as a new paradigm or only as a new perspective which is equivalent to the old one (*Extended Phenotype,* (1982/1989)). But Dawkins finally made it clear that his approach is intended to break with the old benevolent regime of classical ethology and the evolutionary synthesis (e.g., preface to 1989 edition of *The Selfish Gene*). Here the hypothesis is supported that there is indeed a new sub-paradigm with a certain inner cohesion.

[560] E.g., R. Dawkins, *The Extended Phenotype* (1982/1989), p. 4 and ➲ footnote 74.

[561] R. Dawkins, *The Selfish Gene* (1976/1989), pp. 11, 23 f., 254 f.; *Replicator Selection and the Extended Phenotype* (1978), p. 68; *The Extended Phenotype* (1982/1989), pp. 97 f.

evolution, whether organisms or groups are meant. Because Weismann's barrier allows only a direct flux of information from the genotype to the phenotype – and not the other way round –, the phenotype in the view of gene-Darwinism has to be regarded as epiphenomenal.

In contrast, the advocates of the second step of the evolutionary synthesis emphasised the functional reality of macroevolutionary phenotypic properties, like geographic isolation or founder effect. Correspondingly proponents of the synthesis generally came to accept the reality (evolutionary causal relevance) of phenotypic properties of groups and some, like Mayr, additionally emphasised the reality of the individual phenotypic organism. As far as I can judge, this acceptance of the phenotypic structure became dominant only in the second phase of the evolutionary synthesis. This emphasis may have needed further theoretical clarification to prevent succeeding generations from the scourge of a simplifying interpretation of Weismann's barrier.

Later this gene-Darwinian radicalization of the central dogma of microbiology, which I call 'germ-line reductionism' shall be discussed in detail (➲ pp. 311 f.).

b) Gene-Atomism

An aspect of gene-Darwinism which has to be disentangled from the discussed germ-line reductionism is its atomistic attitude towards genes. If germ-line reductionism, the sole relevance of the genotype, is taken for granted, an atomistic attitude additionally means that within the genotypic side of evolution only single selfish genes and not genomes or gene pools as wholes are causally relevant.[75] Genes are competing for survival and in principle they are in conflict even within a single body.[562] In this respect gene-Darwinism puts itself in contrast firstly to Weismann's generally holistic understanding of the organismic germ-plasm, and secondly to the evolutionary synthesis, whose early proponents focused on gene-*pools* and whose later proponents have focused on natural populations.

Despite this, the single selfish-gene viewpoint owes much to earlier Darwinian paradigms. It generally shares a reductionistic spirit with Darwin and Weismann, although those authors did not extend reduction to a thorough sub-individual reductionism.

But the atomism of Gene-Darwinism more directly finds its main source in the first step of the evolutionary synthesis. This synthesis of genetics with mathematical models of unstructured populations (➲ pp. 125 f.), partly developed by Fisher, incorporated the perspective of separate independent genes in a common unstructured gene pool.[563] Based on this Fisherian phase or wing of the synthesis, Dawkins – abandoning the focus on the gene-pool – still favours the idea of the primordial independence of single egoistic genes.[564] Because of this shared gene-

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[562] R. Dawkins, *Replicator Selection and the Extended Phenotype* (1978), pp. 71-72.

[563] G. C. Williams, *Adaptation and Natural Selection* (1966), pp. 3-4.

[564] R. Dawkins, *The Selfish Gene* (1976/1989), p. ix. Dawkins according to the index of his first three books mentions Fisher on a total of 34 pages and Dobzhansky not at all.

atomism gene-Darwinism mirrors Fisherism in a nominalist understanding of genomes as wholes and individual organisms.

This nominalism is linked to the concept of random mixing during genetic recombination and to the chance interpretation of the first variational step of natural selection. On an evolutionary time scale genomes or organisms are only evanescent confederations of approximately immortal genes, and because of this ephemeral character they are regarded as unreal.

According to Dawkins, neglecting the concept of a gene-pool still present in Fisherism, not populations but single genes are the units of selection.[565] The paradigm shift becomes obvious, not only in regard of the different positions of the unit of selection debate, but already in what different problems these approaches are interested in; whereas speciation was an important question of the second phase of the evolutionary synthesis, Dawkins never summoned up much enthusiasm for 'the species problem'.[566] Correspondingly the spotlight of gene-Darwinism is not on the Hardy-Weinberg equation, but on the formulas of Hamilton and Trivers.[567]

As already mentioned, there are additional differences to the second step of the evolutionary synthesis, because Dobzhansky had emphasised the contextuality of genes and Mayr has focused on phenotypes as existing wholes.[568] Nevertheless, even during the second phase of the synthesis, the Fisherian inclination towards 'bean-bag genetics' was not completely superseded.

However, the emergentist attitude of the second step of the synthesis both in regard of new evolutionary entities and a limited pluralism of evolutionary factors, like drift or founder effect, also made the concept of group altruism possible. In contrast to this view and to classical ethology, group selection and group altruism are anathema to proponents of pure gene-Darwinism.[569] The rise of new textbooks in the spirit of the new sociobiological paradigm corresponds to an increase of a "kind of unsentimental, dog eat dog, language".[570] All animal communication, even within species, is now interpreted "as manipulation of signal-receiver by signal-sender" and in terms of "arms races".[571] Now generally mistrust, manipulation and exploitation is the normal gene-Darwinian yardstick. Every explanation which seems to confirm group altruism is regarded as anomalous and that in turn automatically leads to its critical reassessment.

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[565] *Ibid,* p. 10.

[566] R. Dawkins, *Universal Darwinism* (1983), p. 404.

[567] In R. Dawkins' *The Selfish Gene* (1976/1989) Hamilton and Trivers are universally quoted, whereas the Hardy-Weinberg principle is not mentioned at all. Nevertheless, Hamilton himself reconsidered his early view on this matter, ➲ footnote 1035.

[568] ➲ footnote 528.

[569] It has already been shown in earlier sections that Dawkins denies the possibility of group selection. Cf. also G. C. Williams, *Adaptation and Natural Selection* (1966), pp. 4 f.; Ch. 5 to 8.

[570] R. Dawkins, *The Extended Phenotype* (1982/1989), p. 56.

[571] *Ibid,* pp. 57, 61. Also: R. Dawkins, J. R. Krebs, *Animal Signals: Information or Manipulation?* (1978).

What I have called 'gene-atomistic reductionism', or 'gene atomism' for short, that is, the concept that single genes are the exclusive causally relevant agents of biological evolution, will critically be discussed in detail in Part IV.[572]

c) Darwinian Process Monism

Finally, we will now analyse the differences of gene-Darwinism to other largely Darwinian sub-paradigms in regard of the evolutionary process itself.

Gene-Darwinism is usually a paean, praising pan-adaptationism and pan-selectionism and is built on the metaphysics of universal Darwinism[573]. In this regard gene-Darwinism appears to be even more Darwinian than Darwin's own approach, because the major, if not exclusive, evolutionary force is natural selection. Darwin did still thought of use inheritance as a source for variation. Moreover, the later Darwin became unsure whether natural selection could universally provide optimal adaptation.[574] Although the evolutionary synthesis, in continuation of Weismann's neo-Darwinism, had dismissed the Lamarckian concept of use inheritance and also defined the variance producing step of evolution in a more strictly Darwinian way as a blind chance process, the synthesis in its second step still allowed a certain causal pluralism. To some extent it took non-adaptive evolutionary factors into account. Moreover, the synthesis introduced some macroevolutionary factors to explain the evolutionary process. For example genetic drift is based on chance fluctuations and an adaptive interpretation would need additional assumptions.[575] It is indeed controversial how far this causal pluralism has distanced the synthesis from Darwinism in its most extreme conceivable sense,[576] but in any case it is clear that gene-Darwinism again started to treat macroevolutionary factors as if they were reducible to the concept of natural selection. Williams emphasised that in his time many discussions in evolutionary biology seem "on the surface to conform to the modern Darwinian tradition", but on careful analysis they were found to imply something rather different. His goal was to purge evolutionary biology from such unnecessary additions to the theory of natural selection.[577] Dawkins is equally clear on that issue: "[A]ll my books have been devoted to expounding and exploring the almost limitless power of the Darwinian principle"[578].

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[572] ➲ pp. 243 ff. (The argumentation of gene-atomism and germ-line reductionism may be not completely separable, but they may support each other and only together build the basis for the conclusion that organisms and groups are ephemeral and epiphenomenal.

[573] ➲ pp. 207 f., 216 f., 339 f., 350 f.

[574] M. v. Sydow, *Charles Darwin: A Christian Undermining Christianity?* (2005).

[575] See my proposal that drift may be interpreted as the chance variation part of a natural selection process on the level of a species and see also my reservations concerning this proposal, ➲ p. 131.

[576] This controversy obviously depends on the question of the definition of Darwinism ➲ pp. 102 and esp. 358 f.

[577] G. C. Williams, *Adaptation and Natural Selection* (1966), pp. 3-4, 270.

[578] R. Dawkins, *River Out of Eden* (1995), p. xii. ➲ Chapter on Universal Darwinism, pp. 207 f., esp. pp. 209 f., 216 f.

Despite the general focus on natural selection, it should not be neglected that the rise of gene-Darwinism was accompanied by the introduction of the concept of kin selection and the reintroduction of the concept of sexual selection.

But gene-Darwinism regards the sociobiological mechanism of *kin selection* as a mere logical consequence of gene selection. “If we accept neo-Darwinian gene-selectionism, kin selection necessarily follows. There is, indeed no need for the term kin selection to exist, and I suggest that we stop using it.”[579]

Since the 1960s, with the rise of sociobiology, also the concept of sexual selection as non-random mating became dominant again.[580] Furthermore, the application of this explanation to higher human capacities, like the intellect, has become common.[581] The main proponents of the Evolutionary Synthesis, due to their central assumption of panmictic gene pools, had largely abandoned sexual selection. Although gene-Darwinism has taken up their concept of ‘bean bag genetics’, it on the other hand deviates from another central conception of the early phase of the Synthesis. By accepting sexual selection indirectly the concept of complete random combination of genes is challenged. [582] This in my view corresponds to the fact, already mentioned, that in regard to central equations population-Darwinism (the ‘Evolutionary Synthesis) has been built around the Hardy-Weinberg equations, whereas gene-Darwinism (the sociobiological paradigm) has taken the equations of Hamilton and Trivers as its theoretical centre (though Hamilton himself is in his later work not a strict gene-Darwinian➲ [1035]).

Gene-Darwinism attributes a much more active role to the gene. Gene-Darwinism, in many respects the pinnacle of Darwinism, appears in this regard paradoxically almost non-Darwinian. In my opinion this aspect of gene-‘Darwinism’ even has a tendency to undermine the Darwinian understanding of adaptation to an *external* environment and hence Darwinism itself. However, because gene-Darwinians usually do not put emphasis on this subversive aspect, I will not treat it any further in this historical part, but will examine it later in the systematic discussion.

Practically, the acceptance of sexual selection has not helped to turn gene-Darwinism into a moderate position. This might have been assumed, because Darwin in his later publications, more directly concerned with human evolution, tried to smooth his relatively harsh explanation of the evolutionary process by introducing the less cruel mechanism of sexual selection.[583] But gene-Darwinians not only emphasise the *competition* of *single genes,* but seems to interpret sexual selection only as a convenient term, a mere *flatus vocis,* which – like kin selection[99] – is in principle reducible to the generalised term of gene-selection, and is hence no substantial mechanism on its own.[584] However, the resulting interpretation replaces sexual partnership by an

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[579] R. Dawkins, *Replicator Selection and the Extended Phenotype* (1978), p. 67, ➲ also footnotes 99; 859.

[580] S. J. Frankel, *The Eclipse of Sexual Selection Theory* (1994), p. 182. See also: R. Thornhill, S. Gangestad, *The Evolution of Human Sexuality* (1996).

[581] E.g., M. Ridley, *The Red Queen: Sex and the Evolution of Human Nature* (1993/1995), p. 21.

[582] Later on I will argue that this aspect of gene-Darwinism has an inherent tendency also to undermine its own gene-atomism.

[583] ➲ pp. 112 ff.

[584] Cf. G. C. Williams, *Plan & Purpose in Nature* (1996), p. 31.

unchangeable 'battle of the sexes' and results in a harsher view of relationship than any Darwinian paradigm had ever before. Partnership is represented to be essentially and eternally "a relationship of mutual mistrust and mutual exploitation."[585] The evolutionary synthesis has seen sexual behaviour "as essentially a co-operative venture undertaken for mutual benefit, or even for the good of the species!"[586]

As we have seen already in the first and preceding second part of this work the rise of sociobiology brought not only many interesting stimulations to other subject areas, but also ended the period of relative ideological disengagement of biology. In the following Chapter 5 we will come to the external historical reasons for the development of these paradigms.

But as the influence of radical gene-Darwinism has increased, alternative approaches started to flourish also, which criticise especially gene-Darwinism and even Darwinism in general.

4.5 Criticism – A Better Synthesis in Sight?

Today, not long after the beginning to the 21st century and about 150 years after the publication of Darwin's *Origin of Species*, the question arises once more whether Darwinism, at least in its purified gene-Darwinian form, conveys an inappropriate overall view of life. Since the evolutionary synthesis hardened in the 1970s, criticism became influential and many alternative concepts supplementing 'natural selection' have been proposed and vigorously discussed. Although Darwinism in its broad sense is no doubt the most vigourous and influential approach in biology, there has been an increasing plurality of views within Darwinism, some opposing only radical gene-Darwinism. Others even came to oppose Darwinism in general.[587]

The present crisis resembles the crisis of the radicalised neo-Darwinism between 1890 and 1930. That crisis at the turn at the end of the 19th century had been triggered by the discontent with Weismann's radicalised neo-Darwinism and its apparent inconsistency with new genetic findings and Mendelism. In the last decades, framing the turn of the 2nd millennium, the disputes are again triggered by a radicalisation. This time the Evolutionary Synthesis, especially in continuation of its Fisherian wing, has been radicalised by what has here been called 'gene-Darwinism'. But this radicalization called forth the explication of alternative approaches not only in philosophy of biology but in biology itself. Gene-Darwinism in an openly disdainful sense has been called 'ultra-Darwinism'[588] and leading advocates of the second phase of the evolutionary synthesis, like E. Mayr, have opposed a Selfish Gene's point of view, and

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[585] R. Dawkins, *The Selfish Gene* (1976/1989), p. 140.

[586] *Ibid,* p. 140.

[587] For historiographic overviews on developments in evolutionary biology in the last decades see, e.g., P. Bowler (1984), Chapter 12; D. J. Depew, B. Weber (1995), pp. 347-427; N. Eldredge (1996/1995); St. J. Gould (2005); E. Mayr (1991), pp. 141-164; F. Wuketits (1995), pp. 83-156.

[588] N. Eldredge in *Reinventing Darwin* (1995) uses 'ultra-Darwinism' extensively with a meaning similar to my term 'gene-Darwinism' (e.g., pp. xi, 4, 35 f.). But sometimes he uses 'ultra-Darwinism' to denote positions, for which I would not use 'gene-Darwinism', e.g., referring to an account that treats phenotypes and populations as being real (his p. x, 57; ➲ footnote 106).

have explicated more clearly that they see whole populations or species as units of selection or macro-evolution.[589] Refined models of group selection – which took the challenge of gene-Darwinism seriously - have been developed[590] and recently even E. O. Wilson, doyen of sociobiology, reinterpreted the case of eu-social insects, taken as paradigmatic example for kin selection replacing group selection, as being coherent with group selection.[591] Moreover, at the intersection of biology, economics, and human psychology several evolutionary mechanisms have recently been postulated that go beyond kin selection and direct reciprocial altruism, such as cooperator choice[592], indirect reciprocity,[593] strong reciprocity,[594] and altruistic punishment[595]. Although it is an open debate whether these mechanisms can be understood along reductionist gene-Darwinian lines as epiphenomena, the approach advocated here suggests that these mechanisms may well be genuine evolutionary mechanisms – as actually explicitly postulated by some of the mentioned authors. However, I shall not discuss these novel approaches in detail here – most of them became popular after this book was edited the first time. Nonetheless, I think the general discussions of reductionism will shed light on these and other approaches as well.

Additionally, the highly successful paradigm of gene-Darwinism and its far-reaching application to culture came into conflict with traditional systems of morality (cf. Chapter 2). As in the first crisis of Darwinism, a flourishing theoretical pluralism within biology – now generally more moderate – challenged radicalised Darwinism. Apart from new models of altruism and group selection, biology faces pluralism in many areas reaching from genetics to ecology. New conceptions of selforganisation have emerged and old developmental conceptions have reappeared in the so-called evo-devo debate. Punctuated equilibrium, new genetic mechanisms, and dynamic systems theory challenge ultra-Darwinism and in part even Darwinism itself. If Darwinism had not to start to struggle for its life, it at least needs to struggle for its unity and its proper definition.

The central tenets of gene-Darwinism – exclusive focus on selfish genes, gradualism, pan-selectionism and pan-adaptionism – have led to heated controversies in the public and in academia. Certain biologists and philosophers of biology attacked gene-Darwinism to vindicate both the ontological and epistemological existence of

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[589] E. Mayr, *Animal Species and Evolution* (1963), p. 621; *One Long Argument* (1991), p. 145.

[590] See E. Lloyd *The Structure and Confirmation of Evolutionary Theory* (1988/1994); E. Sober, D. S. Wilson, *Philosophical Work on the Unit of Selection Problem* (1994/1998), E. Sober, D. S. Wilson, *Onto Others* (1998).

[591] E. O. Wilson (2005). Kin Selection as the Key to Altruism: Its Rise and Fall (2005). Cf. E. O. Wilson, Hölldobler. *The Superorganism* (2009); D. S. Wilson, E. O. Wilson. *Rethinking the theoretical foundation of sociobiology* (2007).

[592] A. P. Melis, B. Hare, M. Tomasello. *Chimpanzees Recruit the Best Collaborators* (2006).

[593] M. A. Nowak, K. Sigmund. *The dynamics of indirect reciprocity* (1998); M. Milinski, D. Semmann & H.-J. Krambeck. *Reputation helps solve the 'tragedy of the commons'* (2002); M. A. Nowak, K. Sigmund.. *Evolution of indirect reciprocity* (2005).

[594] H. Gintis. Strong Reciprocity and Human Sociality (2000); E. Fehr, U. Fischbacher , S. Gächter. Strong reciprocity, human cooperation and the enforcement of social norms (2002).

[595] E. Fehr, S. Gächter. *Altruistic punishment in humans* (2002). Cf. recently S. T. Shutters. *Strong Reciprocity, Social Structure, and the Evolution of Cooperative Behavior* (2009).

higher genetic units, phenotypes and populations as causal relevant wholes and even an ontological reality of ecosystems. Darwinian gradualism has been challenged. Furthermore, it has been maintained that other forces than exclusively natural selection play irreducible roles in evolution, i. e. chance mechanisms (drift etc.), moderate versions of Lamarckian mechanisms, Baldwinian mechanisms or developmental constraints. The connection of natural selection and adaptation has been dissociated by R. C. Lewontin, who has claimed that natural selection does not necessarily always lead to adaptation. (In economic terms we may say he broke with the belief in a biological *invisible hand.*) Hence, all main aspects of gene-Darwinism have been challenged.

As in the time before the Evolutionary Synthesis, it is today not clear, how a new different synthesis may finally unite most of these proposals.[596] Although there are signs of a convergence even on the side of gene-Darwinism, the influence of their austere research programme seems to be undiminished.[597] One group advocates that the old evolutionary synthesis is generally open enough to provide a framework for most of these approaches.[598] The opposed group advocates a more fundamental theoretical turn, but is far from being united. Some of them want to expand Darwinism into a multi-level Darwinism; others want to supplement or even replace natural selection either by less blind mechanisms or by mechanisms which are not adaptive, but based on chance or structural constraints. Furthermore, some rather favour a historisation of nature replacing scientific universal rules by narratives; others favour an even stronger reliance on mathematics and physics in the context of the complexity revolution[599].

a) New Views in Micro- and Macrobiology

The present criticism of the gene-Darwinian subparadigm and also of Darwinism in general is motivated by new empirical results and new theoretical concepts. It is convenient to distinguish developments in microbiology and in macrobiology.

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[596] M. v. Sydow, *Darwin's Heritage – Still Open to Debate* (2004).

[597] But R. Dawkins in *River out of Eden* (1995) in regard to gene-atomism seemed more guarded than before. Dawkins' central metaphor of this book, the branching digital river of genes, refers mainly to species, not to single genes. *In this respect* his position seems to resemble the one of the evolutionary synthesis, which he had always opposed (e.g., pp. 4-6, 20, 29, 35. f.). But even in this respect Dawkins finally seems to get back to his old conclusions (pp. 5, 28, 118, 121-122). Moreover – as far as I know – he has never explicitly renounced his original gene-atomism or germ-line reductionism central to his most influential book *The Selfish Gene* (➲ also footnote 62). In any case, gene-Darwinism is far from becoming extinct and its ordinary followers are inspired by the original paradigm.

[598] This is mainly advocated by moderate proponents of the second phase of the synthesis, like E. Mayr in *One Long Argument* (1991), esp. pp. 147, 149, 164, and finds its result in textbooks, like D. J. Futuyma, *Evolutionsbiologie* (1986/1990), who is incorporating the heterodox views into the framework of the evolutionary synthesis.

[599] E.g., D. J. Depew, B. Weber, *Darwinism Evolving* (1995), pp. 315-316, Chapter 15-16.

Microbiology had already been an obstacle to Darwinism at the time of the first bloom of Mendelian genetics (de Vries and Bateson). Afterwards Mendelian genetics had been absorbed into the evolutionary synthesis by combining it with statistical models of biological populations. Also the discovery of the actual structure of the germ plasm, the double helix of DNA, by James Watson and Francis Crick in 1953, and the discovery of the biological protein synthesis at that time gave support to the largely neo-Darwinian Evolutionary Synthesis.

Starting in the 1960s, and particularly in recent decades, genetics has undergone fundamental developments at a breathtaking and even increasing path. At the turn of the 20th century, it again appears possible that genetics becomes an obstacle to Darwinism, especially for the concept of genetic atomism, but perhaps even for the evolutionary synthesis as well, and thus for Darwinism in general (➲ also, for instance, pp. 377 f.)

(1) The *neutral theory of protein evolution*, firstly stated by the Japanese population geneticist Motoo Kimura in 1968, is based on the information redundancy empirically found in the protein synthesis. In this process different triplets of nucleotides encode the same amino acid, and in many proteins different amino acids are equifunctional. Thus, mutations in the sequence of amino acids only seldom lead to phenotypic change and most mutations are not 'visible' to selection. Moreover large parts of the DNA are not read at all during the DNA-RNA-transcription. Kimura follows from these facts that the central genetic role of natural selection has to be reduced. Kimura's neutralism alternatively rather focuses on the chance accumulation of mutations.

Kimura's theory has also been connected with the conception of a 'molecular clock', assuming that the changing rate of an allele has its own fixed tempo.

(2) The *operon model* of the French geneticists Francois Jacob and Jacques Monod was stated in 1961. It was an important step to show an inner organisation of the genome. It was shown that the expression of structural genes is controlled by regulatory genes. If a regulatory gene mutates or structural genes come under the regime of a different regulatory gene this can result in sudden huge changes of the phenotype. Although Monod counts as a proponent of Darwinism, his approach enabled a new far more active and organised understanding of the genome and a new form of saltationism.

(3) In the further development of genetics genes have increasingly been seen not as mere genetic atoms, but as being parts of a highly contextual and complex genetic system of functional 'checks and balances'. For instance, the Oxford physiologist and systems biologist Denis Noble has compellingly argued for flexibility of the organisms' regulation of gene expression and the idea that there is no privileged level of causality in biological systems.[600] Joachim Bauer, in *The Cooperative Gene,* has pointed

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[600] D. Noble, *The Music of Life: Biology Beyond Genes* (2007).

out that genetic regulations may affect even the direction of mutations in a systematic way.[601]

(4) Over the recent decades microbiologists have increasingly identified fine-tuned micro-'machinery' working in each of our cells and highly complex regulation systems controlling our metabolism.[602] In my view this does not provide enough reason to doubt evolution as such, but it may indeed cast doubt on the wastful Darwinian trial and error explanation of evolution.

(5) Microbiology also inspired attempts to revive a – comparatively moderate – version of Lamarck's long-discredited mechanism of inheritance of acquired characteristics. This mechanism is seen as an addition rather than an alternative to a selection theory. [603]

Ted Steele in 1979 proposed that RNA can in fact influence the DNA of the germ cells, just as a retrovirus transmits information to its host's DNA. Steel proposed a process of feedback between the immune system – in his view working on the basis of 'somatic selection' – and the DNA. He influenced the neo-Lamarckian Arthur Koestler, who opposed the Darwinian passive understanding of organisms as mere genetic machines moulded externally by selection (here differential environmental elimination). But it was argued that Steele's heretical empirical results could not be replicated.[604] A similar dispute on the scientific respectability of empirical results took place in regard to the results of Cairns, Overbaugh, and Miller.[605] Lateron Edward J. Steele, together with two co-authors, wrote the book *Lamarck's Signature,* where Steele's original theory has been defended, elaborated and popularised.[606]

Already in the late 1950s H. Termin, who received the Nobel price in 1975, had discovered reverse transcription, which is central for the replication of retroviruses. Actual *gene transposition* had then been proven by Barbara McClintock (1902-1992), also a Nobel laureate. According to McClintock's research, genes could be moved within a chromosome or even between different ones. These results in principle may violate the central dogma of molecular biology. If the transposition is catalysed by certain states in the cell, theoretically an external influence could also have an impact on the genome, and if this takes place in the germ cells it would have an impact on the germ line.

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[601] J. Bauer, *Das kooperative Gen: Abschied vom Darwinismus* (2008). Likewise, I have argued in favor of such mechanisms already in the earlier edition of this work: M. von Sydow, Sociobiology, Universal Darwinism and Their Transcendence (2001), ➲ also p. 377 f.

[602] Cf. M. J. Behe, *Darwin's Black Box* (1996/2006).

[603] E. J. Steele, R. A. Lindley, R. V. Blanden, *Lamarck's Signature* (1998), pp. 1, 6, 11, 23, Chapter 5. A short survey of the precursors of this present Lamarckian attempt is given by e.g., P. J. Bowler, *Evolution* (1984), pp. 319-321.

[604] P. J. Bowler, *Evolution* (1984), pp. 320-321.

[605] J. Cairns, J. Overbaugh, St. Miller, *The Origin of Mutants* (1988). They were opposed by: L. Partridge, M. Morgan, *Is bacterial Evolution Random or Selective?* (1988). D. Charlesworth et al., *Origin of the Mutants Disputed* (1988). R. Lenski et al., *Another Alternative to Directed Mutation* (1989). Quoted in: E. Khalil, *Neo-classical Economics and Neo-Darwinism* (1992).

[606] E. J. Steele, R. A. Lindley, R. V. Blanden, *Lamarck's Signature* (1998).

However, the work of McClintock and the general development of genetics, for example the largely adaptive way in which gene transpositions work, seem to suggest a much more self-organised view of the genome. This presumably will be difficult to harmonise with the perspective of a genome build up by 'selfish' independent genes. One can even say that a more selforganised understanding of genomes and organisms, even if *strict* Lamarckism will remain to be false, in some sense may rather mirror the active Lamarckian or orthogenetic understanding than the originally passive Darwinian one[607].

Macrobiology had resisted integration into the Evolutionary Synthesis more than other biological disciplines, especially in its ecological and palaeontological branches. Some concepts in these disciplines have continuously resembled tenets of romantic biology. In palaeontology – even after Darwinism seized power – the concept of saltationism was still discussed (e. g. Schindewolf, 1950 and even Simpson advocated 'quantum evolution'). In ecology the view of romantic science comprehending ecosystems as 'superorganisms' in their own right, had its peak in the time of the eclipse of Darwinism, but it continued as a undercurrent in biology afterwards. This view has also influenced the philosophy of deep ecology. Today at least some macrobiological ideas are again receiving some support. In the years since this book has first been published many researchers came to oppose the genetic atomism and gradualism of gene-Darwinism. I here only mention two approaches: both focusing on macrobiology, although they both try to be coherent with microbiological evidence as well.

(1) The theory of punctuated equilibrium, first elaborated in 1972 by the palaeontologists Stephen Jay Gould and Niles Eldredge, repudiates the gene-Darwinian paradigm in several respects. [608]

Richard C. Lewontin is another persuasive critic of gene-Darwinism. He has written influential articles together with Gould against ubiquitous adaptation,[609] and could count as his ally. Although Lewontin definitely has an interesting own theoretical viewpoint and standing, and although he comes from the microscopical side of genetics, he will here simply be treated under the same headline.

Although Gould, Eldredge and Lewontin in their earlier publications still followed in the wake authors like Mayr, Dobzhansky, and Wright, at the time as the synthesis hardened in particular, Gould and Lewontin became even critical of the synthesis. Here I will only briefly contrast the position of these three writers with gene-Darwinism, which in this context has also been called 'ultra-Darwinism'[588].

(a) Punctuated equilibrium turns against phyletic gradualism as traditionally postulated by Darwinism. According to punctuated equilibrium the normal status of evolution is one of stasis, of equilibrium and only minor change. Stasis is claimed to

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[607] For such claims the definition of Darwinism and Lamarckism is crucial ➲ pp. 358.

[608] N. Eldredge, St. J. Gould, *Punctuated Equilibria: An Alternative to Phyletic Gradualism* (1972). St. J. Gould, N. Eldredge, *Punctuated Equilibria: The Tempo and Mode of Evolution Reconsidered* (1977). St. J. Gould, *The Structure of Evolutionary Theory* (2002). In 1971 Eldredge had already presented the basic idea of the theory (Gould, 2005, p. 775).

[609] S. J. Gould, R. C. Lewontin, *The Spandrels of San Marco and the Panglossian Paradigm* (1979).

be only rarely punctuated by phases of rapid change and speciation. The theory seems to be reminiscent of the saltationistic tradition of palaeontology.[610] Saltationism could be traced back to Schindewolf and Goldschmidt, and could recently also be found in S. Løvtrup's writings. Proponents of punctuated equilibrium have actually distanced themselves from the *traditional* type of saltationism, since the theory does not postulate macro-mutations or novel genetic processes.[611] Advocates of punctuated equilibrium may even be taken as defenders of Darwinism, because they postulate that punctuation may arise from allopatric speciation only. Although in other writings they do not commit themselves to particular mechanisms causing the postulated pattern, at least this original version reinterpretes evidence that traditionally would have contradicted Darwinism in a way that is at least compatable with the partly Darwinian evolutionary synthesis.

In any case, at least on the level of predictions this theory has clearly saltationist leanings, since it is advocated that stasis and punctuation, opposed to gene-Darwinian gradualism, is empirically supported by the fossil record. In contrast, Darwinian gradualists have tradictionally dismissed the fossil record as not being directly conclusive, because of its assumed incompleteness.

Although gene-Darwinism is opposed to any deviation from gradualism, already the evolutionary synthesis had indeed acknowledged the phenomenon of sudden changes in evolution. Eldredge and Gould (1972) explicitly turned to Mayr's writings on allopatric speciation, geographic isolation, and the founder effect as they formulated their theory.[612] Even Simpson acknowledged periods of rapid change in evolution, which he called 'quantum evolution'; Mayr worked on 'adaptive radiation'[613]. In recent years it was nevertheless especially Gould and Eldredge who emphasised that punctuated stasis is central for evolution and who since the 1970s have defended this claim against the rising tide of gene-Darwinism.

> The biological controversy between gradualism and saltationism is not only much older but also more general. It could be found in the geological dispute between Hutton's (and Lyell's) uniformitarianism and Cuvier's catastrophism; or in history of science, where Kuhn challenged the conception of a continuous scientific approximation of the truth and replaced it by discontinuous phases of normal and revolutionary science. Such parallels might indicate that actually deeper values and metaphysical commitments may be at stake.

(b) Gould and Eldredge differ from the sociobiological paradigm in their claim of some autonomy of macroevolution from microevolution. This concept had also to some extent been present in the second phase of the Evolutionary Synthesis.[614] According to the theory of punctuated equilibrium speciation is the primary source of evolutionary change.

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[610] Cf. M. Wuketits, *Evolutionstheorien* (1995), p. 93.

[611] N. Eldredge, *Reinventing Darwin* (1995), pp. 27, 98, 100; St. J. Gould, *The Structure of Evolutionary Theory* (2002), pp. 781, 779.

[612] N. Eldredge, St. J. Gould, *Punctuated Equilibria: An Alternative to Phyletic Gradualism* (1972), cf. also St. J. Gould, *The Structure of Evolutionary Theory* (2005), p. 779.

[613] A term originally introduced by H. F. Osborn, a proponent of orthogenesis.

[614] ➲ footnote 514.

Especially if such an explanatory autonomy is given, palaeontology could be regarded as an important biological discipline, which has the fossil record at its disposal and hence almost exclusively has empirical access to the long term macrobiological evolutionary process. Gould has argued against the often assumed irrelevance and de facto submission of palaeontology.[615]

(c) Gould, Lewontin and Eldredge, together with the followers of the Dobzhanskyian wing of the evolutionary synthesis, have opposed gene-Darwinism not only in regard of macroevolutionary mechanisms, but – closely linked to this – in regard of the existence of macroevolutionary entities. They, despite some ambivalence and restrictions,[616] have generally vindicated the existence of organisms, populations and species.[617] According to them, evolution and also natural selection work on higher levels of organisation than exclusively on the level of single genes.

(d) They advocated the causal relevance of phenotypes and opposed the exclusive relevance of genotypes.[618] In this regard they continued and radicalised the second phase of the Evolutionary Synthesis, in their recognition that the phenotypic population structure and – at least according to Mayr – the organismic phenotype are uneliminable factors of evolutionary theory.

Besides theoretical reasons for adopting this view, a phenotypic approach is also more suitable for the classical methodology of palaeontologists, who only seldom had the opportunity to study palaeontological DNA.

(e) Gould and Lewontin in particular attacked the simplifying 'adaptationism' of gene-Darwinism.[619] Again, by doing this, they radicalised aspects of the second step of the evolutionary synthesis – here Wright's concept of genetic drift – and argued that especially in speciation random fluctuations – as opposed to adaptations – are central for the evolutionary process.

(f) Finally, proponents of punctuated equilibrium have incorporated tenets, which historically have to be regarded as being originally concepts of romantic biology. Inner constraints, *Baupläne* and an inner developmental necessity and direction of evolution here started to play a role again.[620] This is the case although proponents of this approach still advocate natural selection as a very important factor of evolution.

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[615] St. J. Gould, *Irrelevance, Submission, Partnership: The Changing Role of Palaeontology in Darwin's Three Centennials and a Modest Proposal for Macroevolution* (1983). N. Eldredge, *Reinventing Darwin* (1995), pp. 166, 169. It has been argued that the emancipation of palaeontology even the other way round has been a reason for stressing the autonomy of macrobiology: M. Ruse, *Mystery of Mysteries* (1999), p. 143.

[616] N. Eldredge, *Reinventing Darwin.* (1995), pp. 138, 145, 216.

[617] *Ibid*, pp. 105, 109, 123, 135.

[618] R. C. Lewontin, *Gene, Organism and Environment* (1983).

[619] S. J. Gould, R. C. Lewontin, *The Spandrels of San Marco and the Panglossian Paradigm* (1979), pp. 581-598.

[620] M. Ruse, *Mystery of Mysteries* (1999), pp. 137-138, 141, 144. R. J. Richards at least also sees similarities with an (pseudo-Darwinian) 'older nineteenth-century version' of human nature, *Darwin and the Emergence of Evolutionary Theories of Mind and Behavior* (1987), p. 546. P. Bowler, *Evolution* (1984), 324-325. Despite the stress on inner direction, Gould – taking natural selection still as basic process – has argued against the notion of evolutionary progress, which was central to the Romantics and the pseudo-Darwinians. Ruse has pointed out that

(2) *Systems theory of evolution* stresses that entities have to be regarded as parts of larger systems.[621] This viewpoint is the opposed (or may be the complementary) view to atomism, either of a genetic,[622] an individualistic or a 'speciestic' kind. If such a more holistic approach is applied to ecosystems[623], this can be seen as a demystified form (normally working in terms of *causa efficiens*) of the idea of ecosystems as superorganisms.

Ludwig von Bertalanffy founded a general systems theory at the end of the eclipse of Darwinism.[624] Of course this system theory in turn has older origins. Today systems theories have become influential again. I limit myself to distinguish three sub-schools: (a) The Austrian biologist Rupert Riedl and the philosopher of biology Franz Wuketits revitalised the 'systems theory of evolution' rather as a modification of the synthetic theory than a different paradigm. Also, for example, the German biologist Bernhard Hassenstein (Freiburg) has reformulated processes of variation and natural selection in terms of feedback loops. (b) The Chilean biologists Humberto Maturana and Francisco Varela have put emphasis on the reintroduction of the ancient term *autopoiesis* and rather have favoured a radical constructivist paradigm shift than only a modification of the synthesis. (c) The British scientist James Lovelock has introduced and popularised the concept of selfregulation on the level of the whole planet earth, his so-called 'Gaia-hypothesis' (the historian will be reminded of the Antique concept of *anima mundi*).

As we will see in the next section, in recent years physics, chemistry and information science also contributed to extend and dynamise systems theory so that it has become an even more interesting source for our search for a new synthesis.

b) A Multilevel Synthesis – Darwinism versus Developmentalism?

A huge range of different micro- and macrobiological approaches are in contradiction to or at least different in emphasis from gene-Darwinism. Is there another synthesis in sight? Will this pluralism of alternative proposals be transcended? Where in the theoretical 'space', which is highly dimensional, non-Euclidean and itself changing, will this discourse settle and find again at least a local maximum of truth?

In my view gene-Darwinism, which today plays an important role in sociobiology and in other subject areas, will indeed contribute to such a synthesis. But, although gene-Darwinism is a highly appealing theory in regard of its empirically bold predictions and its theoretically austere simplicity, it will not dominate future

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Gould's understanding of complete random contingency is inconsistent with Christian religion. I would agree with Ruse, but I doubt that Dawkins' unmodified concept of unrestrained struggle for life leads further? See: M. Ruse, *Being Mean to Steve* (2000), p. 4.

[621] Punctuated equilibrium may also owe something to systems theory, especially the notion of a dynamic equilibrium. Lewontin was likewise concerned to analyse different kinds of homeostasis. However, because of their actual influence and because of the palaeontological roots of punctuated equilibrium, punctuated equilibrium is here treated as an approach on its own.

[622] Cf. D. Noble, *The Music of Life: Biology Beyond Genes* (2007).

[623] E.g., W. Wieser, *Energetische und soziale Aspekte der Evolution* (1989), p. 101.

[624] L. v. Bertalanffy, *Kritische Theorie der Formbildung* (1928).

evolutionary theory. In my systematic fourth part of this work reasons for the inconsistency of gene-Darwinism will be given (➲ pp. 245 f.). The evolutionary synthesis would need to change some of its central basic assumptions to incorporate both gene-Darwinian tenets and its alternatives.

If there will be a new unified theory (as an alternative to gene-Darwinism) two multi-level approaches appear to propose themselves:

(1) An approach which accepts many levels of evolution, but which, concerning the evolutionary mechanisms, will still remain predominantly Darwinian. This approach could be called 'multi-level-Darwinism'.

(2) An even fuller paradigm shift, which not only favours a multi-level approach in regard to evolutionary objects, but which also abandons an exclusive focus on natural selection and introduces different or additional evolutionary mechanisms. We may call this 'multi-level-evolutionism', or in the extreme specific case of a rather developmental or romantic approach 'multi-level-developmentalism'.

Both approaches would clearly be opposed to pure gene-atomism and favour a multi-level account of evolution. But concerning the evolutionary mechanisms, multi-level-Darwinism and multi-level-Developmentalism would be the extremes of a continuum. Most present actual authors would have to be placed somewhere in the middle on this continuum: Proponents of the Evolutionary Synthesis, like proponents of Punctuated Equilibrium – and even Dawkins[625] – all have in principle accepted that natural selection *and* chance *and* inner constraints do play a role in evolution. But because gene-Darwinism has vigorously attacked the compromise reached by the evolutionary synthesis, the opponents of this gene-Darwinism were forced to pin-point their own alternative views more distinctly and explicitly. This may have ended the period in which thoughts from many different ideological and philosophical backgrounds had all been easily subsumed under the term Darwinism.[626] (If nothing else of gene-Darwinism remained, this clarification would be an important lasting contribution of this paradigm.)

I am going to outline these rather artificial extreme options, because they could help to understand the possibility space in which a new evolutionary synthesis may take place:

(i) Multi-Level-Darwinism

In biology and philosophy of biology, multi-level-Darwinism tries to overcome the substance reductionism of gene-Darwinism, but in regard of processes remains in radical sense Darwinian, basing its argumentation on a selectionist argument.

Proponents of this approach argue that selection takes place on many levels and hence also these levels are real in evolutionary terms. In a frequently quoted paper from 1970, Lewontin introduced the term '*unit of selection*', arguing in favour of group

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[625] In reaction to Gould and others R. Dawkins, while still holding to his gene-atomism, concedes in *The Extended Phenotype* (1982/1989), pp. 30-54 that there indeed are quantitative constraints.

[626] Also ➲ footnote 404.

selection.[627] Proponents of a selectionist argument may, for example, maintain that the individual phenotypic organism rather than the selfish gene is an entity which is eventually 'visible' to selection, because selection (in the sense of differential environmental elimination and survival) acts on each actual organism. For the time being we will leave aside the discussion of possible objections.[628] It is concluded that organisms hence have to be regarded to be real, because having an effect on entities seems to be a sufficient (if not necessary) condition for being real. There is an increasing number of biologists and philosophers who advocate a refined multi-level extension of individualist Darwinism or gene-Darwinism.[629] Some authors extend a selectionist argumentation even to species or even ecosystems. That an ecosystem may be doomed to become extinct as a whole, may gain some plausibility as we understand that if man destroys other species, he may be next on the list.

Such arguments appear to be valid, only if the whole would indeed have additional properties, which its parts did not already had on their own; in terms of the *Gestalt*-psychology, if the whole is more than the sum of its parts; in terms of variance analysis, if there are not only main effects of the parts, but also interaction effects. But whether there are such effects is of course the very question of the unit of selection debate from the outset. We will currently not engage in this controversial and detailed debate, but will return to it later on (➲ pp. 245 f.). At present we may simply assume that there are ontologically properties on different hierarchical levels, which may play a role in the being or survival of entities. In this sense they would be real and not reducible to or collapsible into each other. Such a view would indeed be at odds with pure gene-Darwinism.

But is this view still Darwinian enough to found a position which we would dub 'multi-level-Darwinism' in its most radical sense? (Remember: we aimed at outlining the most radical positions at the end of a hypothetical continuum of multi-level-theories.) Would the approach outlined before – which in my view would indeed be an improvement compared with gene-Darwinism – be as clearly an Darwinian position as possible? I think not. The outlined approach, although historically clearly inspired by Darwinism, would mean not much more than merely stating that there are higher properties of entity collectives. Such a claim is not an especially Darwinian one. The only additional epistemological aspect would be that the reality of properties would be linked to their role in survival, that is, to the probability of a thing to be or not to be. This argumentation answers the question 'what entities do exist?' with 'entities which change the probability to exist exist'. This answer may be metaphysically interesting, may be true or false, or may be close to a tautology, but does definitely not encapsulate the complete essence of Darwinism.

Natural selection indeed is usually regarded as the core of Darwinism. But the term 'selection' is normally – and in this work as well – used in a weak and in a strong sense: Selection in the weak sense only means the second step of a Darwinian process,

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[627] R. C. Lewontin, *The Units of Selection* (1970).

[628] See ➲ Chapter 8 on substance reductionism.

[629] E.g., E. Sober, D. S. Wilson, *Unto Others* (1998), pp. 100 f. R. N. Brandon, *The Levels of Selection: A Hierarchy of Interactors* (1988/1998).

i. e., elimination or differential survival of entities. In this weak sense it has largely been used in the present section above. But this weak meaning does not necessarily involve notions like replicators, evolutionary lines etc.

Alternatively, selection in its strong sense could mean the whole Darwinian process of blind variation of replicators *and* external selection. Multi-level-Darwinism as a pure paradigm should hence on many ontological levels refer to this natural selection in the strong sense, to a stratification of full Darwinian processes of blind variation *and* external elimination (For questions concerning the definition of Darwinism, ➲ pp. 102, 358). Multi-level-Darwinism in either case carries on the process-monism of gene-Darwinism. Moreover multi-level-Darwinism in its strong sense puts comparatively more emphasis on the first step of or the replicator side of the Darwinian process and is hence less concentrating on the second step concerned with phenotypes: Dawkins, who has emphasised the importance of replicators, regards phenotypes only as their 'vehicles'; correspondingly he argued that in this strong sense of selection there is only one exclusive unit of selection, i. e. that of selfish genes.[630]

But in principle this replicator and vehicle argumentation may also be applied to gene-pools as wholes, for example. Gene-pools as wholes may also be regarded as replicators which as vehicles, phenotypic groups, become selected (➲ already p. 131).

> Lewontin, although he coined the term 'unit of selection', should not be classified as belonging to such a radically Darwinian multi-level-approach, because he does not exclusively focus on natural selection and is one of the main proponents who fought against pan-adaptationism.[631]

The first replicational or variational step of evolution is bound to the notion of a 'replicator'; the second eliminational step of evolution is bound to the notion of phenotypes as mere 'vehicles' (Dawkins)[632] or the notion of an 'interactor' (D. Hull)[633]. Here one may already detect an interesting unity of processes and objects. However, why use the two terms 'interactor' and 'vehicle'? On the first view these notions seem to resemble each other, but the interactor-terminology Hull (who always has advocated the species-as-individual-view) seems to concede at least a somewhat more active role to the phenotype (➲ pp. 219 f.). If we are in search for the purest version of multi-level-Darwinism, the notion of a mere vehicle seems to me to be more clearly and purely Darwinian – in its present radically neo-Darwinian understanding – and finally more problematic.

In the following chapters we will see that multi-level-Darwinism tends to be extended to an all-pervasive approach.

In Chapter 5, on the external history of Darwinism, we will see how biological Darwinian theories developed in interaction with non-biological Darwinian

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[630] Selection here is obviously meant in its strong sense, because Dawkins bases his focus on the gene when interpreting a full Darwinian process.

[631] ➲ footnote 619, 627. Also the way how he has proposed the hierarchy of Darwinian processes has itself been contrasted to a replicator-vehicle approach. H. Plotkin, *Darwin Machines and the Nature of Knowledge* (1994/1995), pp. 82-101.

[632] R. Dawkins, *The Selfish Gene* (1976); cf. *Replicators and vehicles* (1982b).

[633] D. Hull, *Units of Evolution: A Metaphysical Essay* (1981).

approaches. Today these theories with which Darwinism interacted may provide the material for a universalised multi-level-Darwinism.

Darwinian processes found in such different areas will be focused in Part III, with Chapter 6 and 7. The specific non-biological theories based on a Darwinian process will be described in detail in Chapter 7. In Chapter 6 we aim at unifying these accounts within a more general metaphysical approach, which I will call 'Process-Darwinism' (➲ pp. 216 f. 221 f.). Process-Darwinism could be understood as a metaphysics, because its ontological (and epistemological and ethical) demands are ubiquitous and exclusive. Moreover it is an almost archetypal metaphysical theory because in regard of its abstractness, its explanatory power, its simplicity and also its connection to actual sciences. It is a theory of which metaphysicians have long dreamt of. If the paradigm of pure gene-Darwinism declines, multi-level-Darwinism intuitively appears to be to be the next step, because it still shares the processes with gene-Darwinism, but incorporates much of the criticism against the gene-atomism of gene-Darwinism. I had to find out that the actual historical development had already drawn this inductive inference and already many contributions on (universal) process-Darwinism have been made (e. g. Campbell, Dennett, Hull, Munz and Plotkin). Often these proposals still sustain pan-selectionist and pan-adaptationist beliefs.

Although I think we have to work our way through all-pervasive process-Darwinism, I think inconsistencies of this approach could also be shown (➲ Part IV, pp. 336 f., 339 f., 350 f.). Although process-Darwinism is in some respects indeed a wonderful approach from which much can be learned, and although process-Darwinism in my opinion would definitely be an improvement compared with gene-Darwinism, it is in my opinion still built in a too one-sided way on the Darwinian metaphor, focusing more on competition than on co-operation and more on the passive process of being selected than on the active process of selforganisation. This critique of process Darwinism will be substantiated in Chapter 9.

(ii) Multi-Level-Evolutionism: Developmental Approaches and Selforganisational Approaches

The other extreme approach of the assumed continuum of possible multi-level accounts, would be a far-reaching replacement of natural selection; we called it multi-level-evolutionism (evolution here meant in remembrance of the original connotation of the term). Natural selection on different levels would not any more be regarded as necessarily the only essential mechanism of evolution, to which all other mechanisms are in principle reducible.

Approaches which are critical towards Darwinism could generally proceed in two ways: They may firstly start from a given, even radically Darwinian starting point and only thereafter try to 'reconstruct the ship on the open sea', i. e. to supplement the ubiquitous Darwinian mechanism by additional processes, constraints etc. The other procedure would be to build independently an alternative conception of the unfolding of nature. In either cases, the focus could already be on the evolutionary beginnings or (possibly additionally) on the further evolutionary process, which, in its further course, is itself regarded to be a changeable object of evolution.

> My own approach in the present work starts from within radical Darwinism and then tries to show the need to extend or even in some respects to transcend this paradigm, already partly concerned with the beginnings, but even more pronounced when concerned with the further course of evolution.

We have already outlined above some specific contributions in micro- or macrobiology which have appeared to be at odds with Darwinism. Presently, we want to outline a multi-level-approach which also breaks with the emphasis on Darwinian processes. In the following two general multi-level-approaches will be described, which – independent of questions of procedure – may in my view contribute to a radical extension or even replacement of Darwinism.

(1) *Multi-level-developmentalism*, which in aspects was revitalised during the last decade, fully breaks with the predominant focus on Darwinian explanations. This approach with a focus on an inner structural or morphological logic is a reformed version of what we have called romantic biology,[634] linked with terms like 'Morphogenesis', 'Rational Morphology' or '*Entwicklungsmechanik*'.

> For reasons of simplicity we here also subsume other non-Darwinian evolutionary approaches which are not strictly romantic, but which also have opposed the sole dominance of causa materialis and causa efficiens, like e. g. the neo-Aristotelian or neo-Thomist teleological approach of Spaemann and Löw.[635] This is done, since different philosophical understandings of nature, which could not easily be harmonised with Darwinism, have moved closer together.[636]

The romantic (or dynamic transcendental-idealist) tradition could be traced back to the pre-Darwinian biology of Oken, Geoffroy St. Hilaire, the late Owen or at least to the 'romanticising materialist biology' of Buffon and Lamarck, who advocated at least also an active understanding of the organism.[634] The tradition of romantic biology was taken up in a modified way, mainly during the eclipse of Darwinism, by Conrad Hal Waddington, D'Arcy Thompson, Hans Driesch and later again, for example, by Jean Piaget.

Today, the biologist Brian Goodwin[637] and his school explore the possibilities for reviving a similar hierarchical theory of forms, which puts emphasis on the reality of organisms, and opposes a purely Darwinian approach to biology.[638]

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[634] For an introduction to pre-Darwinian biology ➲ pp. 87 f.; for a treatment of what we called romantic biology ➲ pp. 95 f.

[635] On R. Spaemann and R. Löw see: R. Isak, *Evolution ohne Ziel?* (1992), esp. p. 145.

[636] On a Thomistic-Whiteheadian metaphysics see e.g., J. S. Felt, *Proposal for a Thomistic-Whiteheadian Metaphysics of Becoming* (2000).

[637] Goodwin did his PhD studies at Edinburgh under Waddington.

[638] G. Webster, B. Goodwin, *Form and Transformation: Generative and Relational Principles in Biology* (1996). Although also the authors put themselves in the above tradition (e.g., pp. ix, 7), they also differ in some respects from the tradition they come from (e.g., pp. 10 f.). B. Goodwin, G. Webster, J. Wayne-Smith, *The 'Evolutionary Paradigm' and Constructional Biology* (1992).

(2) The second possibility for building a multi-level-theory without any or without a main focus on Darwinism appears to be linked to theories of *selforganisation* or dynamic systems theory.

We have already mentioned contributions to systems theory in the last section, especially in their application to macrobiology (➲ pp. 152).

But there are also scientific theories not yet mentioned, which are less closely linked to biology but coming out of physics, chemistry or information science still have a generalist aim. Most of them dynamise and extend systems theory. I am only going to list some of these approaches: the theory of dissipative structures (I. Prigogine), the theory of synergetics (H. Haken)[639], the theory of co-evolution of macro- and microcosm (E. Jantsch)[640], the theories of deterministic chaos (E. N. Lorenz & B. Mandelbrot), and the conception of an 'elastic' ecosystems (C. S. Holling). Other important names in these quite heterogeneous areas are: H. von Foester, W. Krohn and G. Küppers.[641] It is still not clear how or even if these theories could be integrated into a larger well defined theory, but they might be integrated into a dynamised and enlarged systems theory, the theory of *selforganisation.*

Selforganisational approaches often have developed in isolation or in opposition to Darwinian approaches; or sometimes are regarded rather as a completion than an alternative to Darwinism. In my opinion both views are true in a certain respect. Perhaps the future will show that Darwinism and theories of selforganisation are compatible complementary parts of a future synthesis. Still dynamic systems theory at present is best understood as an antithesis to entity and process atomism and the passive understanding of entities normally found in full-blown Darwinism.

Could selforganisational approaches clearly be distinguished from the above romantic or developmental approaches? It seems that theories of selforganisation have their roots rather in physics, whereas multi-level-developmentalism is directly linked to philosophy and the romantic tradition of biology. Moreover, developmentalism more openly favours the importance of form or morphology, whereas theories of selforganisation seem to stand in a rather mechanistic tradition. In this sense multi-level-developmentalism appears to be the more radical alternative to Darwinism.

Actually a closer investigation may well show that both approaches have quite similar roots, which could both be contrasted to Darwinism. Moreover, both approaches focus on systemic organisation (whether it is called form or system) rather than on microscopic components.

Depew and Weber, for example, have stressed that the developmentalist tradition is not at odds with, but has been revitalised by complex systems dynamics.[642] Webster and Goodwin also tie their own originally more traditionally morphologically inspired

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[639] H. Haken, *Synergetics: An Introduction: Nonequilibrium Phase Transitions and Self-Organization in Physics, Chemistry, and Biology* (1977/1983).

[640] E. Jantsch, *Die Selbstorganisation des Universums: Vom Urknall zum menschlichen Geist.* (1982/1988).

[641] A bibliography on this topic: R. Paslack, P. Knost, *Zur Geschichte der Selbstorganisationsforschung* (1990).

[642] D. J. Depew, B. Weber, *Darwinism Evolving* (1995), pp. 395 f.

approach to new approaches concerned with dynamic complexity.[643] Similarly, a German research group on 'critical evolutionary theory' at Frankfurt on the Main at the Senkenberg museum appears to combine aspects of a morphological organismic argumentation (based on hydraulic and energetic physical construction principles) with concepts drawn from theories of selforganisation.[644]

A convergence of developmentalism and theories of selforganisation has not necessarily got to be a surprise: morphological and field-theoretical approaches often claim not only romantic legacies, but a further (dynamised) Aristotelian legacy. The notion of 'selforganisation' – as often ignored – in its literal translation also reminds us of the Aristotelian term *autopoiesis*.

In this chapter we have worked out three different Darwinian paradigms and also outlined the present and mainly biological criticism of gene-Darwinism and Darwinism in general. By discussing the Darwinian sub-paradigms it becomes clear that Darwinism is itself not as united, not as easy to define and not as unchangeable as it is often supposed to be. In the following part we will work out the external influences, which moulded these paradigms, in order to reveal what additional non-biological theoretical background may also be at issue when we discuss these paradigms.

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[643] G. Webster, B. Goodwin, *Form and Transformation: Generative and Relational Principles in Biology* (1996), p. 130 and final Chapter.

[644] Members of the group have been W. F. Gutmann, M. Grasshoff, J. L. Franzen, D. S. Peters, M. Gutmann, M. Weingarten etc. See, e.g.: M. Weingarten, *Organsimen – Objekte oder Subjekte der Evolution. Philosophische Studien zum Paradigmenwechsel in der Evolutionsbiologie* (1993), pp. 2, 279 f..

Chapter 5:
The External History of Darwinism – From Whig Biology to Neo-Liberal Biology?

In the present chapter a survey of the main cultural, intellectual and ideological influences on the formation and further development of Darwinism will be given. This *external* history complements the account on the *internal* history of different Darwinian subparadigms, given in Chapter 4. It will be shown that the development of Darwinism is not only due to an inner logic of biological conceptions and empirical findings, but also underpinned by philosophical and methodological assumptions, which partly came from outside biology.

To describe this development of the different successive Darwinian paradigms exclusively by the sentence 'from Whig Biology to Neoliberal Biology' appears to me rather too radical and over-simplifyingly political, but I think it indeed contains a grain of truth; hence I have put this sentence into the headline, though only as a question. The evidence for an interaction of politics and economics with biology will be summarised. To accept such an interaction should not imply a mono-causal understanding of history, neglecting the role of inner-biological theoretical necessities and empirical evidence.

A simple one-to-one relationship between scientific theories and external metaphysical commitments or values could normally not be given, because the definition of a scientific theory on the one side, the description of dominating values on the other side and finally the historical endeavour to establish a link between these sides are all three complex cultural processes.[645] To acknowledge this complexity by no means implies that the external aspect of the history of science should be ignored; on the contrary there is a need to supplement the internalist approach, often competently treated by scientists themselves, by a profound externalist approach. Although the link between a certain scientific theory and certain metaphysical commitments (and vice versa) will normally not be deterministic, we may still search for probabilistic links between them. Although Darwinism in general, in my opinion, owes much to some general metaphysical commitments, this might be disguised by differences between its subparadigms. Hence to differentiate between different Darwinian subparadigms, each (again in a probabilistic way) with their specific metaphysical commitments may help to reveal and clarify the essence of Darwinism and of its metaphysical commitments.

My external approach to Darwinism does not focus on the socio-economic background (without from the outset regarding this as irrelevant), but on intellectual ideas. Besides the possible influence of some political or socio-economic *theories,* I also want to give an outline of how other intellectual currents like Newtonianism, the

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[645] P. Bowler, *The Non-Darwinian Evolution* (1988), p. 171, ➲ footnotes 404 and esp. 460.

probability revolution and modern reductionism might have influenced the different Darwinian sub-paradigms.

Evolutionism of the early modernity, as we have seen in Chapter 3, already existed before the rise of Darwinism and had to some extent been rooted in Spinoza's and his adherents' approach to give a *unified* account of the World and of God. Since Descartes, the picture of the World had been ripped into two pieces by a dualistic account, which mirrors the Christian distinction of *Machina Mundi* and *Alter Deus.*[646] Opposed to this, romanticism and romantic biology followed Spinoza's approach, focusing on the active (ideal) unfolding of Nature or – in other words – on the self-realisation or incarnation of God.[647] It has been argued that Buffon, the founder of what I have called 'romanticising *materialist* biology', had been influenced by Spinoza and came to a more *active* understanding of matter and evolving entities than Darwin did.[648]

Darwinism – as I am going to show – has interpreted the originally romantic idea of evolution along *atomistic*, mechanistic lines. By explaining evolution in terms of unchanging, eternal, mechanical laws of nature the concept of evolution was transformed and placed in the respected Newtonian research tradition predominant at Darwin's time, especially in Britain. Newtonianism in turn could be regarded as a peculiar blend, on the one hand, out of the mechanicism based on the Christian notion of *Machina Mundi,* and, on the other hand, out of the atomistic, reductionistic and individualistic tenets, present in the increasingly nominalistic attitude at the end of the mediaeval period.[649]

But Darwinism at the same time undermined Newtonianism, on which it relied: God's eternal law is largely reduced to a process of blind chance. God became blind. This aspect of the Darwinian revolution of evolution had already been foreshadowed by the development of the philosophy of will, which had changed the romantic approach from a purposeful unfolding of nature or God, to a blind development of the universal will. To Arthur Schopenhauer (1788-1860) in his work *The World as Will and Representation* (1818) the will is the general driving force of the development: everywhere: "the will [...] is obviously at work [...] but in blind activity."[650] This concept is radicalised by today's gene-Darwinian paradigm, which in some respects could be regarded as pinnacle of pure and radicalised Darwinism. In this paradigm God is 'a blind watchmaker'. Still, in my opinion, this biological world-view also bears the seeds to partially undermine itself, and even Darwinism in general.

But first we start with Darwin, who brought the conception of a largely blind evolution into the realm of the respectable Newtonian research tradition.

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[646] ➲ pp. 73 f., pp. 79 f.

[647] ➲ Section 'd) Idealism and Romanticism – The Dynamic Trial of a Unification', pp. 82 ff.

[648] ➲ pp. 9087 ff.

[649] ➲ pp. 75 ff.

[650] A. Schopenhauer, *The World as Will and Representation* (1818, transl. 1883), p. 118.

5.1 Darwin – A Malthusian Synthesis of Romantic and Newtonian Thought

The biological precursors of Darwin, who had already formulated the building blocks of Darwin's theory of descent, without creating a coherent whole, have already been mentioned in Chapter 4 on the internal history of Darwinism (➲ pp. 106 ff.). Here I shall try to give an account of the external, more general influences which moulded and constrained the composition of Darwin's theory as a whole.

It has been argued that in the times of Darwin there was a certain (scientific) *Zeitgeist in Britain* which made the development of Darwinism more probable there, than, for example, on the European continent.[651] This is supported by the fact that Darwin *and* Wallace, who concurrently developed roughly the same theory of evolution by natural selection, were both British.

Alternatively, one may argue, that the empirical evidence for the Darwinian theory was overwhelming and because of the expanding British empire, naturalists, who sailed the world, were often British. The conception of geological transformation at Darwin's time had anyway become largely accepted in many countries, and the fossil findings provided striking empirical evidence for evolution.[652] Darwin and Wallace had the extraordinary opportunity of getting insight from an enormous amount of empirical evidence. Darwin's voyage on H. M. S. Beagle (1831-36) around the world and Wallace's journey to the Amazon and Malay Peninsula gave them both the possibility to observe related species on different islands.

Although empirical argumentation surely played a role, it also is plausible that this argumentation had to be complemented by a certain *Zeitgeist* in Britain. In France and Germany the concepts of romantic and Lamarckian biology with their claim of evolution and ideogenesis had been common much earlier than in Britain.[653] In France and especially in Germany there was at this time a huge number of competent professional biologists.[654] Additionally, it would be wrong to assume that these biologists were completely isolated from the new empirical findings from the new colonies. Since the founding of Linnaean school of taxonomy many biologically educated explorers from different countries had the same opportunities as Darwin and Wallace; in Germany Humboldt, Leichhardt and v. Müller, for example. But still the theory of evolution by natural selection was not developed in these countries. Additionally, the biographies of Darwin and Wallace show similar influences. For example, both were entrenched with a Newtonian ideal of science, both read Lyell during their travels, both were exposed to romantic or French materialist proposals of

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[651] J. C. Greene, *The Kuhnian Paradigm and the Darwinian Revolution in Natural Selection* (1971/1981), pp. 49, 54. S. S. Schweber, *The Wider British Context in Darwin's Theorizing* (1995), pp. 36-38, also stressing the Scottish influences on Darwin.

[652] For example, Herschel, as Darwin met him already in 1936 in Cape Town, had already written a letter to Lyell, criticizing Lyell for not grasping the implication of his own theory of gradually evolving landscapes for the successive appearance of new species. Mentioned in: A. Desmond, J. Moore, *Darwin* (1991/1992), p. 185.

[653] ➲ pp. 90 ff. Also: E. Mayr, *The Growth of Biological Thought* (1982), pp. 388-391.

[654] E. Mayr, *The Growth of Biological Thought* (1982), pp. 389.

evolution and both read T. R. Malthus' *Essay on Population*[655]. Thus, it seems to me to be a reasonable working hypothesis to accept that the intellectual milieu in Britain has played a role in the parallel development of the theories of Darwin and Wallace.

In the next three sections I will give reason for the claim that for Darwin three external influences were of special importance: (1) Romantic and the 'romanticising materialist' concept of evolution; (2) Newtonian thought, which provided the general pattern of a mechanical, universal explanation, and (3) economic thought, especially of Malthus (but also of A. Smith), which gave to this synthesis the specific Darwinian spin.

Of course, the influences on Darwin were much more complex and diverse. For example, Darwin, after reading Comte, noted that he generally agrees with Comte's positivistic approach.[656] But given that the manifold of influences on Darwin needs to be structured I think the three described schools could be regarded as corner stones of Darwin's philosophy.

> Before we come to discuss these influences, I have to concede that the claim of any *synthesis of Newtonism and Romanticism* at first glance might appear absurd. As already outlined, Newtonian thought and romantic thought were traditionally two *opposed* currents. Moreover, Darwin got beyond *both* Newtonism *and* Romanticism: Darwin firstly abandoned the strictly nomothetic character of Newton's laws, accepting a probabilistic law and by this turned *against* the Newtonian (in a sense still Platonic) world-view of an unchangeable eternal world. Darwin secondly rejected most of the metaphysical presumptions which had been at the very heart of romanticism. His theory is not based on ideogenesis, but is a mechanistic theory based exclusively on *causa efficiens*. It is only reasonable to speak of Darwin's synthesis of Newtonian and Romantic thought if we see it – like most syntheses – as a partial synthesis which also changes the adopted aspects of the synthesised schools.

a) Romanticism and Romanticising Materialism

Only quite recently some historians of thought claimed that one "of the most significant and distinctive features of the positivist historiographic tradition has been its denial of the positive contribution of Romanticism to science." [657] It has already been shown that romanticism generally had a larger impact on the development of modern science than had often been assumed.[658] This also holds for Darwinism, although some of today's neo-Darwinians sometimes tackle history with surprising ignorance.[659] Historians increasingly see Darwinism not only as breaking with romantic biology and with what I have called 'romanticising materialist biology', but as continuing at least some aspects of these traditions.[660] Darwin's concept of evolution,

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[655] E.g., R. Willmann, *Evolution im Duett* (2008).

[656] Ch. Darwin, Notebook M (Ed. P. Barrett, 1987), orig. pp. 69-70. See also e.g., A. Desmond, J. Moore, *Darwin* (1991/1992), pp. 260-261.

[657] E. Richards, *The Romantic Gestation of Nature* (1990), p. 130. See also: P. Bowler, *The Non-Darwinian Revolution* (1988), pp. 5, 19, 29, 31, 48 f.

[658] ➲ Sections on Romantic Biology, pp. 82 f. and pp. 95 f.

[659] ➲ footnote 210.

[660] E. Richards, *The Romantic Gestation of Nature* (1990). See also: P. Bowler, *Charles Darwin* (1990), pp. 17-32.

despite using different explanatory mechanisms from his predecessors, was itself no *creatio ex nihilo.*

Even in *the time* before romanticism, in the late enlightenment, the general idea of development or evolution gained more and more influence. For example, the pre-critical Kant, independently followed by Laplace, proposed in 1755 a hypothesis on the dynamic formation of planets, the so called Kant-Laplace nebular hypothesis.[661]

Nevertheless, since the 'romanticising' materialist and romantic idealist movement (➲ pp. 82 f., 90 f., 95 f.), the concept of universal development became central to philosophy as well as to science. In particular, in biology a romanticising materialist biology and romantic idealist biology spread the idea of evolutionism.

I treat the influences of these two different – partly opposed – schools of thought together, because both made Darwin at least prepared to finally outgrow his belief in the fixity of species and than motivated him to work out his – quite different – explanatory account of evolution. Moreover, both schools had been influenced by Spinoza. Correspondingly the (romanticising) materialist school advocated a more active notion of matter and had a firmer belief in progress than Darwin had. The idealist school had a belief in the necessary progressive unfolding of form. Moreover, despite the differences in their reception especially in England, both schools for example in the early evolutionary debate in France were allied in the persons of Lamarck and Geoffroy against Cuvier. Also after 1859 both schools became allies against Darwinism[662].

Although it is credible that Darwin indeed long believed in the fixity of species, the notion of evolution was at any rate 'in the air'. The theories of Lamarck, Geoffroy and some German romantics were known – also in Britain. Grant, Knox, Green and later Chambers and even Owen were clearly in favour of these concepts, although Owen became cautious in publishing them. Although Darwin's intellectual starting point indeed was indeed a Paleyan-Newtonian understanding of the world, it would be wrong to neglect the influence of the Pre-Darwinian evolutionary theories, both of romanticising materialist and romantic biology.

Darwin, like most of his generation, read Romantic poetry. Darwin in his youth and also in the time he adopted his belief in evolution took much delight in reading poems of Byron, Scott, Coleridge, Shelley and Wordsworth.[663] The romantic poets in a poetic way have expressed ideas also advocated by Romantic biology.[664]

Charles of course knew of the evolutionary speculations of his famous grandfather Erasmus and read his medico-evolutionary book *Zoonomia* while studying medicine at Edinburgh (1825-27). Although Charles at that time presumably was not transmutationalist he greatly admired Erasmus' work and he even himself concedes in his autobiography that hearing early in life of such evolutionary views may probably have moulded his own – of course different – account.[665] Being the grandson of the known

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[661] I. Kant, *Allgemeine Naturgeschichte und Theorie des Himmels* (1755).

[662] P. Bowler, *Darwin* (1990), Chapter 9, esp. p. 167.

[663] Ch. Darwin, *Autobiography* (Ed. F. Darwin, 1887), pp. 33, 69, 100.

[664] ➲ footnote 260.

[665] Ch. Darwin, *Autobiography* (Ed. F. Darwin, 1887), p. 38.

early evolutionist and poet Erasmus Darwin surely played a role in putting the species question on Darwin's agenda.

Erasmus has to be classified as a romantic biologist or at least as a romanticising materialist biologist. Erasmus favoured the belief in the improvement of species by their "own inherent activity"[666]. D. King-Hele, who has edited Erasmus' letters, writings and life, has even argued that Erasmus' writings did not only resemble the writings of the romantic poets, but that he directly made his mark on Blake, Wordsworth, Coleridge, Shelley, Keats and also on Goethe.[667] Coleridge for example, a good friend of the romantic biologist Green, thoroughly knew Erasmus' works. And, Darwin although finally turning strongly against Erasmus' approach[665], kept his work in mind as he himself adopted a concept of evolution. After re-reading the *Zoonomia*, he even took this title as opening heading of his Notebook B, his first notebook mainly on species transmutation[668].

In his second year at Edinburgh, Darwin was under the tutelage of the transformist Grant. Grant was mainly influenced by a Lamarckian view of evolution; to a certain extent only he was also influenced by romantic biology (e. g. by Geoffroy) in adopting the theory of recapitulation.[669] Grant advocated that species have certain life cycles. His transformist leanings were evident in his papers in Jameson's *Edinburgh Philosophical Journal.*[670] Grant and Charles Darwin – the grandson of Erasmus Darwin – became closely acquainted. Darwin also helped Grant with observations on the larvae of molluscs and sea-mats, which played part in Grant's evolutionary attempt to show homologies from people to polyps, and Darwin even had to look something up in a publication of Lamarck for him.[671] Once, as they were walking together, Grant "burst forth in high admiration of Lamarck and his views of evolution".[672] Although in his autobiography Darwin assumed that listening in silent astonishment to this position was "without any effect" on his mind,[672] it certainly suggested this research topic to him.[673]

Generally, most idealist or materialist evolutionists in Britain had a predominantly Scottish, mostly Edinburgh, training.[674] Knox, gave lectures on Comparative Anatomy fully based on the principles of 'Autenrieth, Goethe, and Geoffroy' exactly in the

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[666] E. Darwin, *Zoonomia* (1794), Volume I, p. 505, quoted by D. Kohn in Ch. Darwin, *Notebook D* (Ed. D. Kohn, 1987), pp. 170.

[667] D. King-Hele, *Erasmus Darwin and the Romantic Poets* (1986), esp. pp. 275-280.

[668] Ch. Darwin, *Notebook B,* (commenced about July 1837, ed. D. Kohn, 1987), orig. pp. 1 f.; Kohn's introduction, pp. 167-168.

[669] R. J. Richards, *The Meaning of Evolution* (1992), pp. 71-72.

[670] A. Desmond, *Robert E. Grant: The Social Predicament* (1984), pp. 200.

[671] A. Desmond, J. Moore, *Darwin* (1991/1992), pp. 37-39.

[672] Ch. Darwin, *Autobiography* (Ed. F. Darwin, 1887), p. 38.

[673] See P. Bowler, *Charles Darwin* (1990), p. 21 (refering to: P. R. Sloan, *Darwin's Invertebrate Program, 1826-1836.* In: D. Kohn (ed.): *The Darwinian Heritage.* Princeton Univ. Press: Princeton, NJ (1985), pp. 71-120).

[674] Ph. Rehbock, *Transcendental anatomy* (1990), pp. 11, 32 f. See also: A. Desmond, *Robert E. Grant: The Social Predicament* (1984), pp. 195-202. It has also been argued that generally 'the Scottish enlightenment inquiries on the nature of the social and economic order were evolutionary in outlook'. S. Schweber, *The Wider British Context in Darwin's Theorizing* (1985), pp. 35-38.

years, when Darwin was at Edinburgh.[675] Darwin did not hear Knox's extra-academic lectures himself, presumably mainly because he was disgusted by dissecting anyway.[676] But Knox' lectures were the largest anatomical classes in Edinburgh, even in British history,[677] and it seems improbable that Darwin, who took an active part in the naturalist societies, should never have heard about his ideas. Even the respected R. Jameson, curator of the University's Natural Museum, to whose course Darwin went, had – anonymously – published a paper in praise of Lamarck's mechanism of evolution.[678] Darwin, who had almost stopped studying medicine, took part in two naturalistic societies, which were among the most probable places in Edinburgh to find students or lectures concerned with these topics. One was the Plinian student society, founded originally by Jameson, at that time penetrated by radical students. To the other, the *Wernerian Natural History Society* in Jameson's room in the museum, Darwin was regularly brought by Grant as his guest. Knox had already become a member of this society in 1821.[679]

At Cambridge, while studying theology Darwin mainly strengthened his Newtonian understanding of science (➲ pp. 168 f.). Still, Darwin also read A. v. Humboldt's *Personal Narrative* with great interest and later on as he published his *Journal of Research* modelled on Humboldt he even sent him a copy. Humboldt delightedly answered his letter, mentioning that, for him, Erasmus Darwin had been a source of inspiration.[680]

On the H. M. S. Beagle, Darwin had leisure to examine Lamarck's *Histoire naturelle des animaux sans vertèbres* and he found in the second book of Lyell's *Principles of Geology* a full presentation of Lamarck's theory of evolution and also an outline of Serres' and Tiedemann's concept of recapitulation of the embryological development through stages of lower animals. Despite Lyell's disapproval of these theories, he substituted nothing in their place[681].

Although Darwin – like Lyell – seems not to have become convinced by these evolutionary concepts of his time immediately, all these ideas probably played a role in preparing him for his later conversion to evolutionism. And indeed, at least in the

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[675] *Ibid,* p. 41.

[676] A. Desmond, J. Moore, *Darwin* (1991/1992), pp. 42-43.

[677] Ph. Rehbock, *Transcendental Anatomy* (1990), p. 40.

[678] A. Desmond, J. Moore, *Darwin* (1991/1992), pp. 40, 42.

[679] A. Desmond, J. Moore, *Darwin* (1991/1992), p. 37. Ph. Rehbock, *Transcendental Anatomy* (1990), p. 37.

[680] Humboldt to Darwin 18th Sept. 1839. In: *The Correspondence of Charles Darwin*, Vol. 2 (1986). Darwin in his early notebooks mentions Humboldt repeatedly. S. Herbert, *Introduction to Darwin's Red Notebook* (1836/1980), p. 16. Humboldtian science combined Romantic holism, emphasis on large-scale phenomena and aesthetic sensibility with a new enthusiasm for meticulous empirical description and measurement. Humboldt, in his younger years wanted to write 'a history and geography of plants or historical information on the gradual dispersal of plants over the whole globe' (1805). Humboldt's later works were mainly devoted to present distributions, but I can not judge how far his early intentions are still recognicable in these works. The pre-Darwinian evolutionist Franz Unger is also normally placed in Humboldt's research tradition. See: S. Gliboff, *G. Mendel* (1999), pp. 219-220. E. Mayr, *Growth of Biological Thought* (1982), p. 442.

[681] See: D. Hull, *Darwin and the Nature of Science* (1983), pp. 68-70.

early part of the period between March 1837, when Darwin actually converted to the belief of transformism of species, and before September 1838, when he arrived at his theory of natural selection, passages in his notebooks indicate a understanding of evolution which could be attributed to some romantic brand of evolution. For example, Darwin directly after adopting his belief in evolution claims that evolution works 'per saltum'.[682] Moreover, in this period he also studied not only Cuvier, but also Geoffroy's *Principles de philosophie zoologique* (published 1830).[683]

The historian Richards has argued that Darwin's very early reflections on transformation largely followed a romantic concept of embryological-zoological recapitulation. Thereby Charles Darwin followed in the footsteps of his grandfather Erasmus Darwin and found confirmation of his views in an article of Serres, a disciple of Geoffroy.[684] Moreover, Martin Barry's representation of von Baer's treelike conception of the vertebrate and invertebrate archetypes and their development (1837) might have inspired Darwin's conception of common descent.[685]

> The theory of common descent, to Darwin, as earlier presumably to Geoffroy, was so useful because it acknowledged the evidence of two opposed schools. It firstly acknowledges the unbridgeable difference of species, which had been advocated by essentialists, like Cuvier and, at that time, by Owen (with whom Darwin rubbed shoulders), at least in a 'horizontal' sense. It secondly acknowledges the concept of 'vertical' transmutation.

Even later on, as Darwin in 1842 and 1844 prepared first systematic unpublished formulations of his theories, he, like some romantic and some former essentialist authors, formulated a theory of periodical change, as a "compromise between static creationism and a totally dynamic model of natural change"[686].

According to Desmond and Moore the discussion of revolution and of Lamarckian transmutation took already place on the streets, as by the mid-forties transmutation was moving "out of the shabby dissecting theatres, [...] into the drawing-rooms"[687]. This was partly due to Robert Chambers anonymously published and journalistically written book *Vestiges of the Natural History of Creation,* which made a romantic understanding of cosmic self-development and progression of nature accessible to a larger public.[688] According to Chambers evolution could be seen as a continuous divine creation.

Anyway, evolution was in the air, long before Darwin published his *Origin.* But to Darwin the materialist Lamarckian notion of evolution in the air smelled like the gun powder of the excesses of the French Revolution. Presumably mainly because of this,

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[682] S. Herbert (Ed.), *Red Notebook of Charles Darwin* (1836/1980), p. 65 (orig. p. 130). Darwin's early views on species change are recorded in the red notebook and the 'transmutation' notebooks B, C and D. These and other notebooks have been transcribed and edited by P. Barrett, P. Gautrey, S. Herbert, D. Kohn, S. Smith (Eds.), *Charles Darwin's Notebooks, 1836-44* (1987).

[683] Ch. Darwin, *Notebook B* (Ed. D. Kohn, 1987), orig. pp. 110 f.

[684] R. J. Richards, *The Meaning of Evolution* (1992), pp. 92 f.

[685] *Ibid,* pp. 108 f.

[686] P. Bowler, *Charles Darwin* (1990), p. 99 (refering to D. Ospovat, 1981), ➲ footnote 401.

[687] A. Desmond, J. Moore, *Darwin* (1991/1992), p. 320.

[688] R. Chambers, *Vestiges of the Natural History of Creation [and Other Evolutionary Writings].* Ed. by J. A. Secord (1994/1844).

Darwin – himself silently thinking about evolution – distances himself from Grant and even witnessed a conspiracy against his old teacher Grant, which was only the first attack in a larger war against him.[689] This was the case, although Darwin, in respect of the source of variation, stayed a Lamarckian throughout his life.[690] But also the other, the idealist romantic, notion of evolution seemed from Darwin's Newtonian viewpoint too obscurantist to be scientifically respectable.

The emphasis of history mainly on the break in the transition from romanticism to Darwinism, underestimates the *continuity in the belief of evolution*. This might partly be due to the overbearing importance Darwin awards to a causal, Newtonian explanation. Darwin indeed in many respects was opposed to some idealistic explanations. Moreover his theory of natural selection undermined romantic biology, which might have caused evolutionists like Knox and Owen to oppose this theory of evolution. The "unity of type", a concept central not only to advocates of a fixity of species but also to dynamic romantic biology, "is" as Darwin pointed out in his *Origin* "explained by unity of descent"[691]. Also because the quickly abandoned static essentialist school of biology shared some notions with romantic biology, it might have been easier to underrate the impact of the second school.

Although Darwin totally transformed the conceptions of romantic and romanticising materialist biology, he started not from blank paper, but was pre-pared and influenced also by the hotly discussed theories of evolution of his day.

b) The Impact of Newtonism – Darwin's Process-Monism

Nearly 200 years after Newton's *Principia* (1687) Darwin's *Origin* (1859) extended Newtonism to biology. Darwin indeed became the 'Newton of a blade of grass' (Kant) and he at the same time also strongly modified, changed and perhaps even undermined the generalised Newtonian approach.

Darwin – like Wallace – has developed his theory in an intellectual *milieu* with strong Newtonian underpinnings:

William Paley's (1743-1805) *Natural Theology* (1802), which Darwin enthusiastically read[692] at Cambridge, where he studied to become a priest, was utterly Newtonian in its spirit. From our today's viewpoint this might appear paradoxical, because to us science – and hence Newtonism – often is conceived being opposed to theology. But Paley indeed was a creationist in a quite Newtonian sense. To Paley, as for Newton – but not for the romantics – the universe *ought* to be seen as world machine. Accordingly, in the beginning of the *Natural Theology,* Paley describes the world with the metaphor of a clockwork. Putting himself in contrast to Kant, Paley, like

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[689] A. Desmond, J. Moore, *Darwin* (1991/1992), pp. 199-203, 274-276. A. Desmond, *Robert E. Grant: The Social Predicament of a Pre-Darwinian Transmutationist* (1984).

[690] ➲ Section 'a) Darwin – Not a Darwinist in the Strict Sense', pp. 106 f.

[691] Ch. Darwin, *Origin of Species* (1859), p. 233.

[692] Letter to J. Lubbock, 22th Nov. 1859: "I do not think I hardly ever admired a book more than Paley's Natural Theology". In: *The Correspondence of Charles Darwin* (1991), Vol. 7, p. 388. Ch. Darwin. *Autobiography* (ed. by F. Darwin, 1887, Charles' org.: 1876), p. 47.

Descartes, advocated that even organisms are machines. But according to Paley organic machines are perfected to such a high degree, that we are forced to postulate the most skilful creator we can imagine, that is God.

The original association between Newtonism and Natural Theology based on the Christian-Platonic notion of *machina mundi* had been pointed out already (➲ pp. 74 f.). The concept of *machina mundi* was increasingly changed from a Platonic to a mechanistic sense. But its original link to the design argument for the existence of God stayed a powerful driving force in the development of the increasingly mechanistic sciences (➲ pp. 76 f.).

It has even been argued (in the tradition of Weber and Merton), that, perhaps due to Puritanism, the link of the new sciences and theology in natural theology had a particularly strong impact in Britain.[693] However, it is undisputed – also perhaps due to the Cambridge Platonism[694] – that both Newtonism and Natural Theology became very influential, especially in England. In Paley's time, particularly at Cambridge, Newtonian science had become predominant.[695]

In Darwin's time Paley, although already dead, was still one of the most important natural theologians. In the late 1820s and early 1830s, despite a then growing fear of deism, England's natural theology was still in bloom, in particular in the natural sciences community at Cambridge. And in this community the young Darwin, really studying 'arts' in order to become a priest, spent most of his time.[696] Darwin, coming to Christ College, moved apparently into the same room where Paley had lived.[697] Darwin had to read other works of Paley for his exams, but although he was not a very ambitious student, he read Paley's *Natural Theology* voluntarily and 'with delight' even after he finished his exams – and it was one of the few books he read at Cambridge which made a permanent impression on him.[698]

Paley does not only leave to Darwin his Newtonian mechanical understanding of Nature, but, by this, the belief in an unchangeable law of God. "As it was in the beginning, it is now, and even shall be: world without end" (*Gloria*). In an irony of history this seems present in today's claims of a universal Darwinian Metaphysics.

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[693] See: R. Groh, D. Groh, *Religiöse Wurzeln der ökologischen Krise* (1990/1991), pp. 36-40, 43-47. These authors regard optimistic Puritan (Calvinist) and Anglican denomination as most inclined to develop the argument of natural design (also p. 30). The Lutheran (evangelical) Protestant denomination had been less prone to adopt the design argument, because of its pessimistic emphasis on the original sin and its emphasis on faith as opposed to predetermination (pp. 25, 27, 29, 37). But the Grohs also annotate that there were also Catholics (p. 51) who argued in favour of a (deistic) natural theology based on the new sciences. Additionally, they concede there were many reasons external to science and religion, especially the optimism linked with the increasing importance of Britain (p. 37), for the flourishing of natural theology in Britain.

[694] E.g., H. More, *An Antidote Against Atheism* (1652).

[695] D. Knight, *Romanticism and the Sciences* (1990), p. 14. R. Groh, D. Groh, *Religiöse Wurzeln der ökologischen Krise* (1990/1991), esp. Chapter 'Natürliche Theologie und mechanistisches Weltbild'. D. J. Depew, B. Weber, *Darwinism Evolving* (1995). pp. 99-102.

[696] For an account of the complexities and details of W. Paley's reception at Cambridge, *The Reception of William Paley's 'Natural Theology' in the University of Cambridge* (1997).

[697] A. Desmond, J. Moore, *Darwin* (1991/1992), pp. 63-64.

[698] Ch. Darwin, *Autobiography* (Ed. F. Darwin, 1887), p. 47.

Moreover, Darwin, as personified secularisation, in the time of the *Origin* still preaches largely with unbroken zeal, not only pan-selectionism, but the metaphysical optimism of physicotheology: panadaptionism.[699] Like in a worldly theodicy, Darwin in some writings appears to explain and to justify the necessity of natural suffering by the higher means of natural selection, the origin of life. Finally, Darwin's way from natural theology to natural selection paradoxically led him to demolish the venerable edifice natural theology. After his own biological theory contributed much to make him an agnostic and to shatter his optimistic belief in progress, he again relaxed his adaptationist biological assumptions.[700]

Another important implicit Newtonian influence on Darwin was *Charles Lyell* (1797-1875), who had carried on Hutton's work to introduce Newton's idea of gradual change (of e. g. the gradual change of the direction of the movements of the planets around the sun) to geology. In Lyell's *Principles of Geology* (three volumes, 1830-3, 1872 the 11th ed.) he expounds a theory of geological change not based on a sudden and violent, but on a gradual change. So he took position as a 'uniformitarian' geologist, opposing the 'catastrophists'. Darwin had read the *Principles* on the Beagle and later Lyell became Darwin's academic mentor[701].

> French saltationism and catastrophism might have been associated with the excesses of the French revolution, although they have earlier been advocated by the rather conservative biologist Cuvier. It can not be assessed here, how far such sentiments played a role for dominance of (geological) gradualism in Britain.

More *explicitly* Newtonian was the influence of the famed astronomer *John F. W. Herschel* (1792-1871), who was presumably England's most important 'philosopher of science' in the 1830's. I think D. Hull has been right in claiming that the "Darwinian revolution was as much concerned with the promotion of a particular view of science as it was with the introduction of a theory on the transmutation of species."[702]

In the English speaking world, Philosophy of Science had become a largely independent and self-conscious discipline not much earlier than in the time of Darwin. Hull has argued that there has been two camps: Darwin tried to continue in the vein of Herschel, Lyell and John Stuart Mill, whereas Owen, Forbes and Agassiz followed in the (modified) Kantian wake of William Whewell.[703] In contrast to this view, Ruse has pointed out that, despite differences in the metaphysical aspects of science, Herschel and Whewell were not only close friends, but differed little with respect to 'methodological' questions. Not only Herschel, but Whewell as well paid a lot of respect to the Newtonian research program.[704] However this may be, we will mainly focus on the less controversial views of Herschel here.

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[699] ➲ pp. 339 f., 350 f.

[700] M. v. Sydow, *Charles Darwin – A Christian Underming Christianity?* (2005).

[701] E.g., M. J. S. Hodge, *Darwin's General Biological Theorizing* (1983/1985), pp. 44-48.

[702] D. Hull, *Darwin and the Nature of Science* (1983), p. 65.

[703] *Ibid,* esp. pp. 66, 70.

[704] M. Ruse, *Darwin's Debt to Philosophy* (1975/1989), pp. 12-13, 14, 18, 23.

Herschel, in a Newtonian manner, demands that science should not only search for mere empirical correlations but to explain true causes (*vera causae*), in terms of cause and effect. Still, like Newton, he did not think that this might rule out God, indeed, rather the contrary. In his view to state that there is something not causally explainable, would mean that there is no God, because the Creator works through these 'intermediate' or 'secondary' causes.

Darwin, as an undergraduate, had read Herschel's *Preliminary Discourse on the Study of Natural Philosophy* (1830).

> Darwin, still at Cambridge also knew Whewell quite well and Whewell at the time Darwin returned from his travels seems to have supported Darwin's scientific career. How far he represents a Newtonian or non-Newtonian influence on Darwin could not be assessed here.

Since his travels Darwin also knew Herschel personally. Moreover both were active members of the London Geological Society. Darwin reread parts of the *Preliminary Discourse* in 1838, when he was going to build a theory based on the concept of natural selection. His theory of natural selection should fulfil the criteria set up by Herschel.[705] Among many aspects, Darwin in his theory hoped to provide *vera causa* in the sense of Newtonian 'secondary' causes, of eternal mechanisms. Still, to Darwin's disappointment finally not only Whewell, but also Herschel and Mill dismissed his theory.[706]

In his *Descent of Man* Darwin generally mentions Newton explicitly as the individual who achieved highest status on the scale of the evolution of human mental capacities; and it is also not by chance that Darwin mentions the eternal law of gravity in the last sentence of the *Origin*.[707]

Let us now have a general look in which respect Darwin took over Newtonian thought? What is *Darwin's Newtonism* like? The main and most important feature is that Darwin stated one universal law which mechanistically governs the world of organisms, as the material world is governed by eternal Newtonian laws. As the effect of gravity on stars and on a falling apple could be explained by the same laws, all the special creations of animal species should in Darwin's view be explained by one universal mechanism. Even before Darwin adopted his characteristic mechanism of evolution, he writes in his notebooks: "Astronomers might formerly have said that God ordered, each planet to move in its particular destiny. – In same manner God orders each animal created with certain form in certain country, but how much more simple, & sublime power let attraction act according to certain laws such are inevitable consequen let animal be created, then by the fixed laws of generation, such will be their successors. –"[708] This mechanism later got its final shape by the influence of Malthusianism, but the main Newtonian ingredient is the early deep belief in a mono-mechanistic eternal explanation. This explanation should have no historical or spatial

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[705] See: D. Young, *The Discovery of Evolution* (1992), pp. 114-115, 120.

[706] D. Hull, *Darwin and the Nature of Science* (1983), p. 66. M. Ruse, *Darwin's Debt to Philosophy* (1975/1989), p. 30.

[707] Ch. Darwin, *The Descent of Man* (1874), Chapter IV, p. 194 (implicitly: p. 947); *Origin of Species* (1859), p. 460.

[708] Ch. Darwin, *Notebook B* (Ed. Kohn, 1987), orig. p. 101.

constraints. One mechanism or one set of laws should rule the *whole* of evolution and should rule in all regions of the earth and on all planets where there might be life (although, as far as I know, Darwin did not state this in regard of other planets, he certainly would do this today). Although Darwin had, as has been shown, stepped back in the *Descent of Man* from his radical adaptionism he still largely upheld his mono-mechanistic creed. Throughout time variation had been introduced "by the same general causes, and governed by the same general and complex laws as at present."[709] Giving a universal account of evolution is also Romantic, but to give a mechanistic law is obviously rather Newtonian.

But Newton's influence goes further: Newton favoured a passive understanding of matter.[710] Matter, on which no force impinges, will only act according to its inertia. Hence, the natural movement is straight and not circular, like Aristotle had believed for celestial bodies. Apart from its inertia, the cause for its movement is externally given. To Darwin – if we focus on his theory of natural selection – organisms are not *actively* adapting but are adapted by the *external* force of natural selection. This opposed the Buffon/Lamarckian view of active matter and organisms (➲ pp. 90 f.).

This parallel between Darwin's theory of natural selection and Newton's model of a law bound system of matter in motion has been more fully elaborated by Depew and Weber. According to them, species could be compared to objects, say planets moving around the sun, which have a certain inertial tendency, but at the very same instant they are pulled back by the external force of gravity. Organisms – without any force acting on them – would tend to reproduce similar organisms, but natural selection, like gravity, is acting upon them, causing them to go off this tangent, causing them to transform.[711] Moreover, the "Newtonian construction of the action of the force as occurring incrementally in infinitesimally small steps is also present in Darwinism."[712]

Notwithstanding this parallel, it is still important to see that at the same time as Darwin found a universal law which might meet the Newtonian standards for theories, he also transcended the Newtonian framework. In following Herschel's Newtonian idea of giving a universal causal explanation for the whole process of evolution, Darwin had to pay the price in accepting only a probabilistic law. (Cf. Maxwell on gases, also 1859). Involuntarily Darwin turned against Herschel's idea of *vera causae* as necessary, nomothetic laws. To Darwin's disappointment, Herschel did not approve his theory of natural selection, but as Darwin was told, condescendingly called Darwin's mechanism of evolution 'the law of higgledy-piggledy'.

Darwin had dynamised the conception of nature by introducing on a second level a fixed, ahistorical, eternal mechanism in a Newtonian way. "God was, for Darwin then, still the traditional good and wise creator, but one never working in so many

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[709] *Ibid,* Chapter II, p. 94.

[710] This passive understanding of matter was a central aspect of Hegel's critique of Newton. K.-N. Ihmig, *Hegels Deutung der Gravitation* (1989), pp. 55 f. See also: M. Jacob, *The Newtonians and the English Revolution* (1976).

[711] D. J. Depew, B. Weber, *Darwinism Evolving* (1995), pp. 9, 89.

[712] S. Schweber, *The Wider British Context in Darwin's Theorizing* (1985), p. 49.

separate acts of interference, always through the natural consequences of a few initial enactments of general laws: as with planetary orbits and the law of gravitation."[713] But differently from the Platonic conception the advocated unchanging background of the changing world, is not provided by a universe of eternal forms, but by one blind process of overproduction and elimination. Later, it will be shown that it is disputable, to accept a historisation of nature, but to oppose a historisation of its evolutionary laws (➲ pp. 363 ff., esp. 405 ff.).

In conclusion, it appeared adequate to me to call Darwin the 'Newton of a blade of Grass'[714], a phrase Kant had introduced. Kant himself was convinced that there could in the strict sense never be such a Newton of a blade of Grass; there could never be an adequate explanation for organisms only using *causal* explanations.[715]. In this thesis it will be argued that there is still a need for an Einstein or a modernised Aristotle of a blade of Grass.

c) Thomas Malthus, Adam Smith – The Influence of Economic Thought and Practice

When discussing the external history of Darwinism an often-discussed characteristic of Darwin's theory (and of the later following neo-Darwinian theory) should also be considered; it is its closeness to some central aspects of political economy and social practice of Whig individualism, competition and *laissez-faire* economy. This sort of economy was favoured by A. Smith, Malthus and Ricardo, the then influential British school of 'political economy', and since the middle 1830s these theories had partly become bitter social practice in Britain. The theory of natural selection, according to J. C. Greene, came "naturally to Englishmen" of that time, steeped in this tradition of 'political economy', and correspondingly it "is no mere coincidence that all of the men who arrived at some idea of natural selection in the first half of the nineteenth century – one thinks of William Wells, Patrick Matthew, Charles Lyell, Edward Blyth, Charles Darwin, A. R. Wallace, and Herbert Spencer – were British."[716] A closer scrutiny shows that these formulations of 'natural selection' differ considerably in how far they focus on the struggle of individuals.[717] But a certain resemblance appears to remain. However, I do not base my argument on these parallels. Instead I concentrate on Darwin's theory of natural selection in particular. Though I shall, of course, not claim that Darwin's theory is *merely* a projection of the concepts of laissez-faire capitalism onto nature, it will be shown that it is apparent that Darwin's theory, in some respects, is similar to and was actually inspired by economic thought.

There are two ways to discuss a resemblance of theories of quite different subject matter. Firstly one might work out that there is a structural similarity, an analogy. Secondly actual direct influences, a line of descent, a homology, may explain this

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[713] M. J. S. Hodge, *Darwin's general biological theorizing* (1983), p. 48.

[714] D. J. Depew, B. Weber, *Darwinism Evolving* (1995), p. 113. (➲ pp. 168 f.).

[715] I. Kant, *Kritik der Urteilskraft* (1790/1793/1799), p. 338.

[716] J. C. Greene, *The Kuhnian Paradigm and the Darwinian Revolution in Natural Selection* (1971/1981), p. 49.

[717] P. Bowler, *The Non-Darwinian Revolution* (1988), pp. 41 f; *Evolution* (1984), p. 155.

similarity. If no direct influence could be found, it is reasonable – as in the romantic search for convergent lines of evolution – to search for indirect influences, intellectual resonances, or otherwise for common influences from a third source, in short, reasons to claim that these homologies are due to something which was in the air, which was necessary at least at a certain stage of the *Zeitgeist.*[718] I am firstly going to outline the general analogy of Darwin's theory and some basic tenets of early 'political' economics, which still forms the basis of neo-classical economics. Then, in more detail, I discuss the analogy and actual influence of the theories firstly of Malthus and then of Smith. Finally, we come to discuss the impact of the actual contingent social situation of Darwin's time.

It has often been stated, and I think to a certain extent rightly, that there is a striking *general analogy of theories of (Neo) classic economy and (Neo) Darwinian biology.*[719] The agents in the competition on the free market are, according to the main Smithian presumptions, rational individuals maximising their *own* benefit. Like them, organisms in Darwin's *Origin* are necessarily egoistic individuals, which tend to maximise their *own* reproduction. In both cases resources are scarce. This implies economic competition on the free market – or struggle for existence between organisms. The competition is severest between individuals or firms offering *similar* products, or between most *similar* organisms. Both views focus on competition and both introduce, what I have called 'principle of egoism', mainly on the level of the individual.

Now I come to the discussion of the more specific theory of Malthus. The analogy between Malthus and Darwin, and the actual influence of Malthus on Darwin will be discussed. Darwin himself in the *Origin* described his theory of natural selection as "the doctrine of Malthus applied with manifold force to the whole animal and vegetable kingdoms".[720]

Thomas Robert Malthus (1766-1834), also a Cambridge educated Newtonian clergyman[721], in his *Essay on the Principle of Population, as It Affects the Future Improvement of Society* (1798, 1803, ..., 6th ed.: 1826) stated as a law of nature that human population increases in a geometrical (exponential) progression, whereas the food production of the land can increases only in an arithmetical (linear) way.[722] This, according to him, naturally results in a necessary scarcity of resources,[723] in famine, misery, war and pestilence, which act as 'positive checks' of population growth. Correspondingly, Malthus thought that it was and would never be possible to build a society where all

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[718] This methodology is paralleled by my theory of exformation ➲ pp. 316 f.

[719] This idea has largely been discussed. The idea newly has been elaborated by the economist E. L. Khalil, who criticises both paradigms in a similar way, *Neo-classical Economics and Neo-Darwinism: Clearing the Way for Historical Thinking* (1993), pp. 22-72.

[720] Ch. Darwin, *Origin of Species* (1859), p. 117.

[721] To R. Malthus God is acting by eternal and general laws, *Essay on the Principle of Population* (1798), pp. 159, 353.

[722] R. Malthus, *Essay on the Principle of Population* (1798), pp. 14, 18 f., 21.

[723] *Ibid,* p. 291.

citizens “should live in ease, happiness, and comparative leisure”, an argument which is in his view “conclusive against the perfectibility of the mass of mankind”.[724]

Before Malthus’ time, poor laws had been instituted in Britain to partially remedy the distress of the poor of each parish. Malthus wrote against these poor laws[725]: “The poor-laws of England tend to depress the general condition of the poor”, because of an increased price for food, a more than proportionate increase of population of the poor, and an increasing laziness of the fancied rich.[726] Malthus even went further: “A man who is born into a world already possessed, if he cannot get subsistence from his parents on whom he has a just demand, and if the society does not want his labour, has no claim of right to the smallest portion of food, and, in fact, has no business to be where he is. At nature’s mighty feast there is no vacant cover for him.” Thus, instead of arguing that we should directly strive to prevent or alleviate misery, Malthus recommended a harshening of the conditions of life of the poor. “Dependent poverty ought to be held disgraceful”[727]. Although he tried in the more academic second edition of his *Essay* to soften some of the most remorseless conclusions of the first edition, he still held an extremely critical stance towards welfare.

Because of such a position today one is inclined to call Malthus a pre-Darwinian social-Darwinist. Darwin was born only eleven years after the publication of the first edition of Malthus’ *Essay*. Accordingly, historians, like, for example, Robert M. Young, have emphasised that Darwin’s view of nature arose naturally out the social debates centred on Malthus’ works.[728] Darwin, as we shall see later, read Malthus and he rubbed shoulders with important Malthusians. Here the structural resemblance is important. Darwin’s and Malthus’ works resemble each other in the concept of a necessity of overpopulation, which leads to a general scarcity of recourses and to a struggle for existence. Malthus also provided a mathematical formulation, suited to Darwin’s Newtonian understanding of science. Moreover, Darwin’s belief that individual struggle for existence leads to progress seems to resemble at least Malthus’ general Whig belief that individual competition leads by an invisible hand to the common good.

Internal historians (➲ pp. 102), like E. Mayr, have pointed out that Darwin’s theory was at least not primarily a socio-economic theory, although also Mayr concedes that the reading of Malthus’ was of some importance for Darwin.[729]

P. J. Bowler tried to steer a middle course, accepting that Malthus provided an important step to Darwin’s theory of natural selection, but arguing that Darwin’s and

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[724] *Ibid,* p. 17..

[725] *Ibid,* pp. 74-99, esp. 98.

[726] *Ibid,* pp. 76, 77, 78, 83

[727] *Ibid,* p. 85.

[728] See: P. J. Bowler, *Malthus, Darwin and the Concept of Struggle* (1976), p. 635. R. M., Young, *Darwin’s Metaphor* (1985). A. Desmond, J. Moore, *Darwin* (1991/1992), pp. 267 f., 413-414.

[729] E. Mayr, *Darwin, Intellectual Revolutionary* (1983), p. 33; *One Long Argument* (1991), pp. 69 f.

Malthus' view still differed considerably.[730] Malthus indeed impressed Darwin by his emphasis on an inevitable 'struggle for existence' in general and by the resulting concept of scarcity of resources for the species as a whole. Both emphasise pressure of the environment on populations always tending to expand.[731] But, in Bowler's view, Malthus did not – like Darwin – advocate a struggle on the individual level as a basis for change or progress.[732] The distress of the poor should be held disgraceful, not because poor persons with superior ability should win in the struggle for existence relative to others, but because the general situation should prevent further birth of children and should be a stimulus for the lazy. [733]

These differences between Darwin's and Malthus' position, seem in my opinion to be valid; though I would less stress their importance. Bowler is right, that differential survival is on the individual level clearly less central in Malthus' *Principle of Population* than one would suspect if Malthus had taken a strict 'socio-Darwinian' position. Still, there are some passages, where Malthus in the context of the overpopulation problem and of the Poor Laws draws not only distinctions between few rich and the mass of the comparatively poor, but also within the rather poor. Malthus distinguishes firstly the unemployed very poor of the workhouses, who "cannot in general be considered as the most valuable part" and secondly the "more industrious, and more worthy members", whose part is diminished by the former.[734] Moreover, Bowler himself concedes that Malthus in later editions recognises at least some struggle for existence within species[735] and generally there is also according to Bowler "no doubt that Malthus assumed modern society operated on a basis of self-interest and competition."[736] I think, Darwin, in some respects came to share with Malthus a political view critical towards any state intervention and welfare: [737]

> "The advancement of welfare of mankind is a most intricate problem." If man is "to advance still higher, it is to be feared that he must remain subject to a severe struggle. Otherwise he would sink into indolence and the more gifted men would not be more successful in the battle of life than the less gifted. Hence our natural rate of increase though leading to many and obvious evils, must not be greatly diminished by any means. There should be open competition for all men" [738]

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[730] P. J. Bowler, *Malthus, Darwin and the Concept of Struggle* (1976), pp. 631, 636, 637. Similar: P. J. Bowler, *Evolution* (1984), pp. 96-97, 162-164; *The Non-Darwinian Revolution* (1988), pp. 34 f.; *Charles Darwin* (1990), pp. 82-84. Also: M. J. S. Hodge, *The Development of Darwin's General Biological Theorizing* (1983/1985), pp. 56 f.

[731] P. J. Bowler, *Malthus, Darwin and the Concept of Struggle* (1976), pp. 637, 647.

[732] *Ibid,* pp. 634, 636, 639. (Similarly: E. Mayr, *One Long Argument* (1991), pp. 80-82.)

[733] *Ibid,* pp. 636, 641, 642, the first reason is not mentioned by Bowler, but ➲ footnote 728.

[734] R. Malthus, *Essay on the Principle of Population* (1798), p. 84.

[735] P. J. Bowler, *Malthus, Darwin and the Concept of Struggle* (1976), pp. 638, 647.

[736] *Ibid,* p. 639. See also: P. J. Bowler, *Evolution* (1984), p. 164.

[737] For a more detailed analysis of Darwin's view ➲ the section on the *Descent of Man*, pp. 112 f. In the *Descent of Man* Darwin in fact is in some respects more guarded than in the *Origin.* This is in a way mirrored by the moderating attempts of Malthus' 2nd edition of the *Essay*, where he puts at least some more emphasis on education and self-introduced restrictions, with the hoped result of postponing marriage and reproduction etc.

[738] Ch. Darwin, *The Descent of Man* (1874), Chapter XXI, p. 945.

Bowler worked out, that Malthus did not, at least not explicitly, favour the differential elimination of the unfit, i. e. of the poor, and that he may have hoped that their disgraceful situation would encourage 'slothful mankind' to work.[739] Nevertheless Malthus accepted and demanded such a situation of the poor and accepted even their starvation – of course in the service of achieving a higher good[740].

Moreover, the other structural similarities of Malthus' demographic and economic theory to Darwin's theory make it clear that it was only a little step for Darwin to transform Malthus' theory into his own – albeit different – theory of natural selection. The parallel concepts of natural population pressure, of scarcity of resources, of a general struggle for existence, and of the opposition against poor laws are striking. Already convinced of evolution anyway, prepared by empirical facts and by his population thinking derived from animal breeders, all these tenets – combined with a public conception of Malthus as a proponent of a politics of free labour market and individualistic *laisse-faire* – were missing links for Darwin's formulation of his own specific theory of individual natural selection[741].

The above parallels are not only analogies but at least partly ***homologies***: the concepts are not only similar, but in fact Malthus' approach had been the most important external influence on Darwin's theory of natural selection.

Apart from Darwin's statement in the *Origin*, Darwin also stated in his autobiography that he got the idea for his theory of natural selection on the 28th September 1838 while reading the sixth edition of Malthus' *Essay on Population*[742]:

> "[...] fifteen months after I had begun my systematic enquiry, I happened to read for amusement Malthus on Population, and being well prepared to appreciate the struggle for existence which everywhere goes on, from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favourable variations would tend to be preserved and unfavourable ones to be destroyed. The result of this would be the formation of new species. Here, then, I had got a theory by which to work".[743]

The reading of Malthus had no doubt shaped the similarities of Darwin's and Malthus conceptual core. To acknowledge the importance of Malthus for Darwin's theory of natural selection is in my view not in contradiction to Hodge's or Bowler's argumentation that the reading of Malthus provided only an important step to Darwin's causal theory of evolution.[744]

> Apart from this, Malthus, famous for his strict opposition to the poor laws, ironically *also influenced John Maynard Keynes* (1883-1946), normally regarded as a moderate *left wing* econo-

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[739] P. J. Bowler, *The Non-Darwinian Revolution* (1988), pp. 37-38.

[740] See R. Malthus' almost romantic and almost evolutary theodicee, at the end of his book, *Essay on the Principle of Population* (1798), pp. 354 f.

[741] ➲ pp. 110 f.

[742] The date refers not to his autobiography, but to his notebooks. Darwin's entries on Malthus at least start on this day. Ch. Darwin*, Notebook D* (Ed. D. Kohn, 1987), orig. 134 f., cf. p. 678.

[743] *Idem*, *Autobiography* (Ed. F. Darwin, 1887), p. 83.

[744] M. J. S. Hodge, *The Development of Darwin's general biological theorizing* (1983/1985), pp. 52-54. See also: E. Mayr, *Darwin, intellectual revolutionary* (1983), p. 37. For Bowler's argumentation ➲ section above.

> mist, who supported active intervention of the state in the case of an economic crisis. This influence is not based on Malthus' theory of population, but on his view that cyclical crises in economy are caused by underconsumption.[745] Malthus thought that, for example, the post-Napoleonic War distress was caused by a deficiency in effective demand. This brought him into conflict with his friend David Ricardo (1772-1823), who upheld the so-called Say's Law, stating the impossibility of a general underconsumption and who for this different reason followed Smith's theory of governmental non-interference. However, we are here concerned with Malthus' writings on population, which effected a *laissez-faire* politics.[746]

Darwin had personal ties to outstanding Malthusians of his day and anyway, Malthus' "name was on everybody's lips, as either Satan or Saviour."[747] Darwin, as Desmond and Moore have pointed out, was in contact with relatives and still living friends of Malthus' circle. But more important was that Charles' brother Erasmus seemed to be close to marrying Harriet Martineau, well known for her popularisation of the writings of Malthus.[748] After he came back from his travels Darwin was delighted to join regularly their dinner parties at Erasmus' house, a hive of evolutionary and Malthusian ideas. Here Darwin was imbued with Malthusian ideals of overpopulation, competition and free trade.[749]

Adam Smith (1723-90) could be considered as another economic influence on Darwin's thought. With his main work, the *Wealth of Nations* (1776), the Scotsman and professor of Moral Philosophy is regarded as the reputable founding father of Whig economics, which before Darwin's days had already extended the Newtonian paradigm to economics and combined it with radicalised enlightenment individualism. Smith favours capitalist self-interest, competition, and natural consumer preferences as mathematically describable forces leading to optimal prosperity and freedom.

The foundation of *laissez-faire* economics coincides with the general founding of economics as an independent subject, because now philosophy and politics did not have to define the purposes of the economic development beforehand; instead economics was now regarded as a self-sustained machinery, which had to be examined as a separate science. Although the school of Smith and the early economists in his wake is usually called 'political economy', because till then economy was regarded as serving politics, it would be more appropriate if this school would rather be called the first 'non-political' economics.

There are many structural parallels of Darwin's and Smith' approach:

(1) Smith has to be regarded as one of the modern founders of what has here been called the 'principle of entity egoism' on the level of the individual. Economic agents, capitalists, descriptively do act – and in Smith view even should act – out of self-interest. We have already shown that Darwin had also applied the principle of egoism on the level of the individual organism.

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[745] Some signs of a cyclical theory could indeed also be found in Malthus' *Essay on the Principle of Population* (1798), pp. 31 f.

[746] See: H. Landreth, *History of Economic Theory* (1976), pp. 108-111. D. Winch, *Malthus* (1987), p. 9.

[747] A. Desmond, J. Moore, *Darwin* (1991/1992), p. 197.

[748] *Ibid,* pp. 153, 201, 216.

[749] *Ibid,* pp. 216, 218.

(2) Smith favoured capitalist free competition and the notion of unrestrained competition was central to Darwin as well. To Smith any intervention by government is almost certain to be injurious. Still, of course, the competing agents were, to Smith as to other early liberal thinkers, still bound to basic moral rules.

(3) The concept of 'division of labour' was introduced by Smith into economics. Darwin applied this idea to biology, where it was one source for his idea of speciation with of common descent.

(4) The confidence of Smith in the self-interest of egoistic individuals is also at least to some extent present in Darwin's work. To Smith the sole maximisation of one's own interests is not wicked, as Plato had thought, and will not lead to the collapse of society, but the other way round: it will achieve, as if effected by an 'invisible hand', the wealth of *all* members of a nation. This is mirrored by Darwin's belief, largely present in 1859, that most organismic properties are adapted, and that these adaptations, of species and ecosystems, could be full explained by the egoistic striving of single organisms for their *own* survival and reproduction. In a letter to Lyell, who was critical of Darwin's non-progressive mechanism of evolution, Darwin still wrote: "If I have a second edition, I will reiterate 'Natural Selection', and, as a general consequence, Natural Improvement."[750] As he wrote the *Descent of Man*, this belief in only the level of the individual and in the process of natural selection as the sole evolutionary factor had partly crumbled:

> "[...] I was not however, able to annul the influence of my former belief, then almost universal, that each species had been purposely created; and this led to my tacit assumption that every detail of structure; excepting rudiments, was of some special, though unrecognised, service. Any one with this assumption in his mind would naturally extend too far the action of natural selection [...]"[751]

Besides the structural similarities, the *actual influences* of Smith' optimistic Whig individualism on Darwin is less direct and striking than the influence of Malthus – still it is quite plausible.

Desmond and Moore have argued that the general Darwin-Wedgwood family background was a 'world of wealthy Whiggism'. Not only at liberal Edinburgh, but also later on – despite other influences – Darwin stayed imperturbably a Whig.[752] Cambridge was less a bulwark of 'High Church Thoryism' than Oxford was. Many of Darwin's friends from the (new) scientific establishment, like Babbage, Henslow, Herschel, Lyell, Sedgwick and Whewell, were moderate Whigs. On the one hand, Darwin had argued with staunch Tories, like FitzRoy, on the other hand Darwin shared his "family's abhorrence of the 'fierce & licentious' radicals".[753]

Nevertheless, many of Darwin's moderate scientific Whig friends remained critical of his radicalised Malthusian solution of the species problem. They at least partly looked for a more lawful, inherently progressive and finally also more harmonious solution. Darwin's theory pleased only some aspects of the shared Victorian, and

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[750] Darwin to Lyell, 25th October 1859. In: *The Correspondence of Charles Darwin*, Vol. 7 (1991), p. 358.

[751] Ch. Darwin. *Descent of Man.* Chapter II, p. 92; also ➲ pp. 112 f.

[752] A. Desmond, J. Moore, *Darwin* (1991/1992), pp. xv, 24, 93, 139.

[753] *Ibid,* pp. 90, 93, 104-105, 120, 139, 199, 212.

especially Whig, "cluster of respectable values: a gospel of work, a trust in self-help, a belief in thrift, and a sense of duty as the foundation of character."[754] Although individual effort (opposed to biological determination), 'moral reformation' and the concept of a resulting harmony was to them inseparable from improvement, they indeed also shared a belief in liberalisation and individual competition. But like Smith many Victorian religious Whigs still optimistically believed in a final harmony of self-interest and common good. Bowler has speculated that Smith may have played a role to give Darwin's theory the individual spin, which, as he has stressed, is not explicitly present in Malthus' writings on population.[755] Darwin in fact read some books of Smith. Furthermore, he stated that he acquired the concept of division of labour from Henri Milne-Edwards, who in turn acknowledged that he got this idea from Adam Smith.[756]

In conclusion, it is plausible to assume that Darwin was also inspired by Smith's hopeful belief, shared by many Whigs that individual self-interest finally also leads to the achievement of the common good. Despite this, Darwin not only took a strongly individual stance, but, based on it, also for a while retained a strong belief in the progress and adaptation of a species. Nonetheless, Darwin came to undermine this optimistic belief of the mid Victorian Whigs: competition for Darwin does not lead to the well-being of all members of a species, but only to the surviving ones.[757] Moreover Darwin played a role in undermining religion, on which much of the optimism of the Victorian ethos was based.

Another often mentioned reason why Darwin was prepared for a mainly Malthusian solution of the species problem was the *social situation in Britain.*[758]

When Darwin came back from his voyage on H. M. S. Beagle, while he still was wrestling to build a theoretical structure to bring order into the massive amount of data he had accumulated throughout his travels, Britain fell into a deep economic depression.

Moreover, the rapid growth of population in early and middle Victorian period, the time when Darwin formed his theory and published the *Origin,* seemed to be consistent with the Malthusian population doctrine, although the abolishing of the Poor Laws seems not to have had much overall effect on the growth of population. Only in the late Victorian period there was talk not about overpopulation, but about underpopulation as well.[759]

But also for another reason it could be said that Darwin was returning to a "Malthusian world – Malthus's words had finally been acted on: the old outdoor charity had been scrapped, and the poor made to compete or face the workhouse."[760]

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[754] A. Briggs, *Victorian Britain* (1998), Section on Victorianism.

[755] P. J. Bowler, *Evolution* (1984), p. 162; *Charles Darwin* (1990), p. 84.

[756] D. J. Depew, B. Weber, *Darwinism Evolving* (1995), p. 82. See also M. Ruse, *Mystery of Mysteries: Is Evolution a Social Construct?* (1999), pp. 241-245.

[757] P. J. Bowler, *Evolution* (1984), pp. 94-98, 158; *The Non-Darwinian Revolution* (1988), p. 37.

[758] E.g., J. Browne states the different influence of colonialism, which I do not follow here, *Biogeography and empire* (1996), p. 305.

[759] See: A. Briggs, *Victorian Britain* (1998), Section on population.

[760] A. Desmond, J. Moore, *Darwin* (1991/1992), pp. 154, 196.

Malthus had largely god-fathered the Poor Law Amendment Act in 1834, which had ended the relief for all but the most destitute.[761] F. Engels wrote that the New Poor Law had been "constructed as far as possible in harmony with the doctrine of Malthus, which is yet more barbarous than that of laissez-faire, because it interferes actively in cases in which the latter is passive."[762] Between 1837 and 1842 this in combination with the additional crisis led to enormous misery; riots and starvation were common.[763]

That this social situation prepared Darwin could partly be regarded as the 'social resonance' of Malthus' theory: Malthus ideas on population had affected the Amendment of the Poor Laws, which in turn had the effect that the economic crisis resulted in extreme and widespread pauperism. In this unconstrained capitalism Darwin indeed could have seen Malthusian principles at work and was perhaps prepared by these circumstances to adopt the theory of natural selection from Malthus and even in principle to apply it also to human society. Thus society at the time of this economic crisis and pauperism seemed to confirm Malthus' principles in regard of humans, although – ironically – one can see these principles at least partly as a cause of the misery and not only the explanation of them:

> *Today's demography takes a rather critical stance towards a pure Malthusian approach* and is hence closer to the position of Malthus' opponent Johann Peter Süssmilch (1707-1767): Contrary to the Malthusian principles there actually has been generally more additional production of food than average population growth – even in the case of most developing countries. Moreover, especially in many 'developed' countries with a welfare system, like for example, Germany after the Second World War, the poor were treated not treated in a disgraceful way as Malthus demanded; but the population growth has been comparatively small, in Germany for example even negative. Herwig Birg maintains a demographic *theory of transformation* according to which the birth and death rate changes corresponding to the *social* transformation of a society.
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> The biologist and eminent writer Ernst Ulrich von Weizsäcker also emphasises the high correlation of poverty and the increase of population. According to him, this makes it evident that an increase in population is strongest where children are needed for individual survival, because there is no pension scheme.
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> Thus the consequences of Malthusian theory, to make the human struggle for survival more severe, is diametrical from the consequences, which – I think – have to be drawn from these empirically supported concepts: welfare is not necessarily an obstacle to the reduction

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[761] D. Winch, *Malthus* (1987) pp. 13, 16. According to W. Peterson, *Malthus* (1979), pp. 114 f., Malthus influence was only an indirect one and Malthus also was critical towards the *New* Poor Law, because it was still working within parishes, although to him the 'whole business of settlements [...] is utterly contradictory to all ideas of freedom.'

[762] F. Engels, *The Condition of the Working Class in England in 1844* (1845), quoted in D. Winch, *Malthus* (1987), p. 71. See generally also: R. L. Meek, *Marx and Engels on Malthus* (1953).

[763] It would be interesting to analyse – following a Keynesian viewpoint – whether the abolishion of the old poor laws in a cynical way reduced the demand and hence had itself been a factor in triggering the crisis.

> of growth in populations, indeed it might even be one precondition among others allowing for the reduction of population growth.[764]

Hence, it appears to be correct that Darwin is not only directly intellectually influenced by Malthus' and Smith's ideas, but also by the contingent state of the society in his time, which again had been influenced by economic theories. Although it is wrong to neglect the differences between socio-Darwinism and the originally more optimistic view of, for example, Adam Smith, one can see the point which Karl Marx made as early as 1862 in a letter which he wrote to Friedrich Engels:

> "It is remarkable how Darwin recognises among beasts and plants his English society, with its division of labour, competition, opening up of new markets, 'inventions', and the Malthusian struggle for existence. It is Hobbes' *bellum omnium contra omnes*"[765].

It could be summarised that Malthus' emphasis in his *Principle of Population* on overpopulation, scarcity of recourses and the general struggle for existence, and also the Smithian optimistic belief in the fruitfulness of individual competition, had in many ways influenced Darwin's theory of natural selection. We have worked out the structural similarities between Malthus and Smith, on the one hand, and Darwin on the other. We also traced the ways in which these 'political' economists have actually directly influenced Darwin. Additionally it has been shown that they, especially Malthus, also influenced Darwin via 'social resonance': Malthus inspired the amendment of the old Poor Laws and this was at least one of the reasons for the deterioration of the situation of the poor in the 1830s, which in turn gave support for Darwin's belief that the Malthusian principles were actually at work in society.

Darwin transformed these – at least partly more optimistic – theories of the 'political' economists into his own different theory of natural selection. This theory then was not only applied to biology, but exported back, via various forms of socio-Darwinism, to politics and economics.

We will show that this 'cross-fertilisation' has also gone on in the further development of evolutionary theory. Interaction of theories from different subjects areas is, of course, in principle not negative. However, such an interaction reminds us, like other externalist explanations in history of science that some aspects of a scientific construction of the world *may be* also due to historically contingent factors. For example, the focus on individuals in Darwin's Darwinism, has for various internal and external reasons been shifted in the evolutionary synthesis. Of course, what is seen as contingent is a function of our present systematic position. Moreover, there was an interaction of internal and external reasons for Darwin to adopt his theory. Still to find external reasons, which are contingent, might also inspire our systematic discussion. Also the method of ruling

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[764] H. Birg, *Der überfüllte Planet: Lebenserwartung, generatives Verhalten und die Dynamik des Weltbevölkerungswachstums* (1993), Studieneinheit 27, pp. 25-37. E. v. Weizsäcker, *Erdpolitik: Ökologische Realpolitik an der Schwelle zum Jahrhundert der Umwelt* (1990), pp. 114-115.

[765] K. Marx. 18th June, 1862. In: R. L. Meek, *Marx and Engels on Malthus* (1953), p. 173.

out criticism of the basic presumptions in one of these fields by referring to the other field developed in interaction, becomes suspect.

Writing on the external influences on Darwin's theory, it seems correct to regard his theory not only as a synthesis of romantic and Newtonian ideas, but also one out of Malthusian and Smithian concepts. Besides the also valuable internalist argumentation, we – treating its external history – also have to keep in mind that Darwin in some respects undermined not only romanticism and Newtonism, but also the optimistic and harmonic aspects of Victorian Whiggism. Only in this limited sense, Darwin's Darwinism could be regarded as a form of Whig biology.

d) God – A Blind and Brute Creator?

The atomistic Platonism of the Newtonian search for causal natural explanations and eternal divine laws, at least in its Darwinian synthesis, finally turned against Christianity.

Darwin banned *causa formalis* and *causa finalis* from biology and explained the world in terms of *causa materialis* and *causa efficiens*. The Darwinian paradigm overcame the concept of Platonic, Aristotelian or Kantian forms or ideas. To Darwinians there are no necessary morphological types, no *embranchements* and no regulative idea of wholes which are both their own cause and effect. Darwinism, in a strict sense and not a Victorian misconception of it, also implies no necessary inner logic, no direction and no purpose of evolution – not even as a mere regulative idea. In the Newtonian system of matter in motion, there were only eternal 'atoms' and eternal laws pertaining their movement. But Newton could still think of God, not of an intervening God, but of a God, who governs by harmonious laws, which need neither revision nor supervision. As we have seen, Darwin had similarly adopted a rather deistic stance, before he adopted his theory of natural selection, assuming that God does not actively interact with the world, but acts through secondary causes, Newtonian eternal and universal laws of nature. To assume that God is concerned with the "long succession of vile Molluscous animals", Darwin thought anyway to be "beneath the dignity of him"[766].

Since Darwin combined the Newtonian concept of eternal laws and matter in motion, in a Malthusian way with the romantic idea of evolution, it inevitably resulted in a catastrophe for religious thought. One of the traditional proofs of God's existence was the perfection of the world (the fourth proof of Thomas Aquinas' *Summa Theologiae,* or Paley's mechanist proof). – How could a merciful, good God use such a cruel, blind and wasteful mechanism to create the world? Paradoxically, Darwin in his search for certain, eternal and ubiquitous "laws of harmony"[767] finally adopted the law of natural selection; and by adopting this mono-mechanistic account, harmony metaphysically became based on and explained by struggle. The hopeful Christian credo "As it was in the beginning, it is now, and even shall be: world without end" (*Gloria*) – if in this context applied to man as well – leads to its most cynical or unhappy conclusion: "To prevent the recurrence of misery, is, alas! Beyond the power

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[766] Ch. Darwin.*Notebook D* (Ed. D. Kohn, 1987), 16th Aug. 1838, orig. p. 37.

[767] *Ibid,* orig. p. 36.

of man."[768] Wilberforce might indeed have grasped that this is at least an inclination inherent to Darwinism. Nietzsche, for example, whose philosophy is by some regarded as strongly influenced by Darwinism and at the same time a reaction against Darwinism, was forced to believe that "The total nature of the world, is [...] to all eternity chaos".[769] And it was Nietzsche, who at least as a diagnosis for his present age coined the phrase: "God is dead."[770]

Darwin himself still held a belief in a creator, and even some years after he adopted his theory of natural selection he still struggled with its implication; possibly for psychosomatic reasons he became ill and finally became an agnostic. In Darwin's theory the Platonic element of Newtonian thought is reduced to only one universal and eternal mechanism; which is itself not harmonious, but wasteful and cruel. Hence it appears preferable to become an agnostic – to regard Darwin's mechanism as a 'secondary cause', put in place by God, as Asa Gray in fact still tried to believe, was finally doomed to failure.

If God had created this mechanism, which leads to a purposeless, unchangeably cruel and wasteful development, lacking any direction, he would not be the benevolent God of Christianity: in this framework God becomes a blind and brute demiurge.

5.2 Evolutionary Synthesis – Thermodynamics and the Philosophical Zeitgeist

The evolutionary synthesis, the *second* Darwinian sub-paradigm we have discussed here (for its internal history ➲ p. 123), was externally influenced (a) in its first phase by models imported from the probability revolution, especially from thermodynamics, and (b) – more speculatively – by the change of the more general philosophical *Zeitgeist, episteme*, *nous* or *logos* in the second quarter of the 20th century, corresponding to the changing positivist attitude in philosophy.

a) The Influence of Thermodynamics

There is an impressive structural similarity between population genetics of the *first* phase of the evolutionary synthesis and thermodynamics.[771]

To start with, both approaches explain macroscopic phenomena by the behaviour of large numbers of identical microscopic, unconnected components. Fisher, the arch-proponent of 'bean-bag genetics' during the first phase of the evolutionary synthesis,

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[768] Th. R. Malthus, *An Essay on the Principle of Population* (1798), p. 98, also ➲ footnote 724).

[769] F. Nietzsche, *Die fröhliche Wissenschaft* (1882), p. 109. R. J. Hollingdale, *Nietzsche: The Man and His Philosophy* (1965), pp. 88-90. Nietzsche also retained at least some belief in Lamarckism. Still, paradoxically, his critique of Darwin's and Spencer's theory (both more Lamarckian themselves, than almost any of today's Darwinians) seems to emphasise that Darwin still finally vindicates the values of Victorian England. Spencer, still drawing 'a line of hope' of an eventual reconciliation of egoism and altruism, even more clearly was adopting the decadent 'herd values', which Nietzsche castigated. See also: L. Call, *Anti-Darwin, Anti-Spencer: Friedrich Nietzsche's Critique of Darwin and 'Darwinism'* (1998).

[770] K. Jaspers, *Nietzsche* (1935/1950), p. 247.

[771] D. J. Depew, B. Weber, *Darwinism Evolving* (1995). See also E. A. Lloyd, *The Structure and Confirmation of Evolutionary Theory* (1993), p. 4.

focused on independent genes in an amorphous, ideal gene-pool, as if they were molecules moving independently in an ideal gas, modelled by thermodynamics. Both currents mainly draw from the theory of probability to explain macroscopic effects. In order to save some aspects of the originally deterministic Newtonian research programme the introduction of probability theory was necessary. This was necessary for pragmatic reasons to manage the complexity of phenomena which had to be explained, but perhaps also for deeper reasons – even today the three body problem has no classical solution.

Thermodynamics describes the macroscopic phenomenon of temperature as the average kinetic energy of the molecules in a gas. Similar, evolutionary change is understood as the average change of gene frequencies. In thermodynamics, energy is transferred between molecules as a result of collisions. By assuming that all combinations of molecular motion are equally likely, it can be concluded that this transfer continues until a statistical uniformity or thermal equilibrium is achieved. This probabilistic tendency, called entropy, is stated in the second law of thermodynamics. Transferred into the language of Fisherian population genetics, equilibrium is the state of the best possible adaptation, where no selection pressure is left.[772]

Fisher's radical adaptionism was discarded in the second phase of the evolutionary synthesis, mainly by Wright, Dobzhansky and Mayr. They, as we have seen, rather focused on interaction effects of gene loci and the structure within populations, which are now regarded to be necessary for speciation and for providing the variance for evolution. Moreover, some macroscopic mechanisms had to be introduced into this framework. This second phase is generally regarded as the final realisation of the evolutionary synthesis and for a good while it gained almost unquestioned dominance in biology. Despite these changes many aspects of the statistical view of thermodynamics were taken on board.[773]

Depew and Weber have shown that Fisher's theory was not only *structurally analogous* to the probabilistic and atomistic spirit of thermodynamics, but that Fisher was *actually influenced* by the probabilistic revolution. Besides being impelled by the eugenics-driven biometrical research programme of Galton; Fisher – under the tutelage of the physicist James Jeans – was also directly imbued with the spirit of Maxwell and Boltzmann. In the 1860s and 1870s they had introduced the probability revolution in their formulation of statistical thermodynamics. It still needed almost a half century till the probability revolution in its mathematical formulation reached biology.

Maxwell and Boltzmann thought that they would extend the Newtonian concept rather than replacing it. They related the phenomenological gas laws concerned with temperature, pressure and volume, to the microscopic probabilistic concept of collisions of molecules. But, by doing this, they also undermined the classical Newtonian deterministic framework and introduced a rather statistical view. By the time of Werner Heisenberg, and Niels Bohr, the interpretation of probability changed

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[772] This far going analogy is especially peculiar because entropy generally leads to a decline of order, whereas evolution in this sense leads to an increase of order. (On 'bean-bag genetics' ➲ footnote 506).

[773] For the differences and similarities of the second phase of the synthesis ➲ p. 127.

from a mere epistemological one, to an ontological one. Although the models of Fisher resembled thermodynamics and not quantum mechanics, Fisher adopted those models with an objective interpretation of probabilities.[774]

b) The Impact of the Philosophical Zeitgeist and the Development of Logical Positivism and Logical Atomism?

The general *Zeitgeist* might also have had an impact on origin and establishment of the evolutionary synthesis.

Such a broad hypothesis is of course highly problematic. The assumption that there was a general *Zeitgeist* tends to neglect the differences of various schools and countries at a certain time. Moreover, the notion of a general intellectual climate is too wide-ranging to be supported here. Any such approach is doomed to be relatively speculative. Still, in my view it would be worth neglecting the possibility of more general and indirect influences only for methodological reasons.

Hence I want to steer a middle course; on the one hand I dare to embark into this speculative discussion, on the other I want to delimit its scope in several ways. In the first place the investigation is limited mainly to philosophy. Other interesting parallels, like that of the development of psychology, can only be mentioned[775]. Focusing on this '*philosophy* of biology' I have had to leave aside whether in this period there had even been a 'politics or economics of biology': Has there been a direct political motivation for the way the evolutionary synthesis had been shaped? It would be interesting to examine the hypothesis that the proponents of the second step of the synthesis (stressing the relevance of groups) had been motivated by social commitments of whatever ilk. (Haldane, for instance, sometimes took a socialist perspective.) Moreover, I limit my investigation to only Britain and the US, because these countries seem to me to have been the main – although not the sole – birth countries of the evolutionary synthesis. Finally, I only point to what is, in my opinion, an intriguing parallel. I leave open how these sides are causally linked, whether this analogy is due to direct or indirect influences or whether this is due to inherent developments on both sides or to shifts in the external culture or whether they are mere chance coincidences.

Firstly, we will return to the philosophical climate which was rather metaphysical when Darwinism was on its deathbed. Secondly, we are going to discuss the parallel of the atomistic positivism of the first step of the evolutionary synthesis, i. e. Fisherism, on the one hand, and the philosophy of logical atomism, on the other hand. Thirdly, we will outline the parallel development in the second step of the evolutionary synthesis and in analytic philosophy, both advocating a less atomistic and a more contextual approach.

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[774] Paragraph: D. J. Depew, B. Weber, *Darwinism Evolving* (1995), pp. 243-273. They are partly referring to M. J. S. Hodge, *Biology and Philosophy (Including Ideology): A Study of Fisher and Wright* (1992).

[775] See e.g., L. D. Smith, *Behaviorism and Logical Positivism* (1986).

(i.) Philosophy at the Time of the Eclipse of Darwinism

We have already shown that Darwin himself had been influenced by Newtonism and positivism.[776] He shared the positivists' belief in the crucial explanatory role of science. Although Darwin came from a Christian background and was guarded (not wanting to be recognised as a radical), he de facto established a materialistic theory of evolution which undermined teleology and formal causation in biology. In the 1870s – the heyday of early Darwinism and pseudo-Darwinism – positivism, materialism and empiricism were not only biologically, but also philosophically most influential. When Darwinism was at the height of its powers, even psychology was directed by the promising prospects of a biological perspective, founded on the theory of evolution[777]. The decay of Christianity, the increasingly indifferent or critical attitude of science towards religion, and, even more pressing, the importance of eugenic ideas, and the prevalence of a general biologistic attitude, led to a sharp parallel reaction in philosophy, psychology and biology: Despite earlier influences of idealism in Britain (➲ pp. 95 f.), objective or absolute idealism became pre-eminent in British philosophy by the mid-1880s, although some late Victorian theorists still continued in a Darwinian and Lamarckian vein to apply concepts of biological evolution (partly even in semi-idealistic way) to society and ethics.[778] The main proponents of idealism in Britain were T. H. Green and F. H. Bradley at Oxford and J. Ellis McTaggart at Cambridge.[779] British idealism was to some extent motivated by the search for a religion and an ethics, "which would be less vulnerable to [...] Darwin" and at the same time "nobler [...] than Benthamite utilitarianism".[780] Although earlier, in the days of an unchallenged high church, idealism was hailed as a danger for Christian faith, and indeed idealism and not utilitarianism finally broke down the authority of the clerical party even in Oxford, idealism was revitalised as the remaining promising saviour of the spiritual world against mere materialism. In social regards the idealists favoured a more harmonious community in the face of increasing fears about the fragility of the society.[781]

Although philosophers in Germany had already partly abandoned this position, idealism gained influence almost all over the world as, for example, with the work of Josiah Royce in the United States.

> Likewise different non-Darwinian persuasions blossomed, such as Bergson's conception of life and, later, Whitehead's conception of processes and Husserl's pure phenomenology. Despite the huge differences between these approaches many of these schools were opposed to reductionism, materialism and naive realism. Moreover, communism, philosophies of life and pragmatism gained influence in this time. The general philosophical situation is, of course, more complex and a differentiated assessment of these schools can not be provided here.

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[776] ➲ pp. 168 f. and footnote 655.

[777] L. S. Hearnshaw, *A Short History of British Psychology 1840-1940* (1964), p. 120.

[778] S. M. Den Otter, *British Idealism and Social Explanation* (1996), pp. 1-2, 88-119 (Chapter 3).

[779] The cradle of British Idealism was primarily Oxford. See: *Ibid,* pp. 36-44.

[780] T. L. S. Sprigge, *Idealism*, p. 667, in: Routledge Encyclopedia of Philosophy (1998), Volume 4, pp. 662-669.

[781] S. M. Den Otter, *British Idealism and Social Explanation* (1996), pp. 5, 13, 17, 27, 44.

> Based on the general speculative and metaphysical attitude just mentioned, Bergson's concept of Creative Evolution in particular appears not only to have played a pivotal role during the 'eclipse of Darwinism', but also in the re-establishment of Darwinism later on. Bergson always stressed the irreducability of the 'elan vital' and – although himself partly influenced by Darwinism – generally aimed at developing "a non-Darwinian evolutionism that made room for religion, albeit not for orthodox Christianity"[782]. Nevertheless the concept of indeterministic progress, creativity and the openness of evolution, favoured by this non-Darwinian philosopher, in turn also seems to have influenced some proponents of the largely Darwinian evolutionary synthesis[783].

In biology the pre-eminent anti-atomistic metaphysical tendency in philosophy is mirrored by the eclipse of Darwinism, which started about 1890 and by particular alternative theories such as morphological, orthogenetic and early saltationist approaches. Besides some inherent biological problems within Weismann's neo-Darwinian perspective, this metaphysical tendency presumably played a role in the moral reaction against this radicalised mono-mechanistic explanation of evolution (➲ p. 121) and in the promotion of different evolutionary factors.

During a similar period psychology too was divided into various groups with different philosophical and methodological commitments: there were *Gestalt* psychologists, structuralists, functionalists, early behaviourists and various brands of depth psychologists. This turmoil certainly had some bad consequences, but it served the aspiration of preventing the dominance of a simple psychological biologism.[784]

In philosophy, biology and psychology, at least some of the schools were united in their opposition; still, all failed to construct a consistent, accepted and lasting synthesis.

(ii) Parallels of Logical Atomism and Logical Positivism to Fisherism?

In the 1920s, after the First World War, logical atomism and logical positivism gained influence. Logical atomism has been developed particularly by Bertrand Russell (1872-1970) and – the early – Ludwig Wittgenstein (1889-1951). Logical positivism has been developed by Moritz Schlick (1882-1936), Rudolf Carnap (1891-1970), Otto Neurath (1882-1945), Carl Gustav Hempel (1905-97) and Alfred J. Ayer (1910-89). These two approaches differed in some respects but were united in their interest in mathematical or scientific explanations, and their common opposition to the endless controversies of traditional metaphysics.

Although both these related groups of philosophers saw things differently, the rise of logical positivism and logical atomism in *some aspects* paralleled the rise of the evolutionary synthetic theory. These parallels are described best with the programmatic notions *positivism* and *atomism*:

- *Atomism*: Although Fisher also worked with the notion of populations, Fisher's 'bean-bag genetics', as we have seen, is obviously a strongly atomistic theory (➲ pp. 125, 184).

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[782] A. R. Lacey, *Bergson*. In: T. Honderich. *Oxford Companion to Philosophy* (1995), pp. 88-89

[783] Personal communication with Prof. Dr. Peter Bowler.

[784] L. S. Hearnshaw, *A Short History of British Psychology 1840-1940* (1964).

According to the logical atomism of Russell and the early Wittgenstein we describe the world in a language built of propositions. These propositions can be analysed into elementary independent atomic propositions, which are connected to compound complex propositions by logical operators. These atomic propositions are, according to logical atomism, the only *real* entities – besides logic – in the sense that they are, in the empiricist interpretation, the immediate connection to our sense experiences. In the atomistic vision of Wittgenstein's *Tractatus* these facts can be combined, for example, in a disjunctive way, but this component is not real on its own, but reducible into its components. "Every statement about complexes can be resolved into a statement about their constituents and into the propositions that describe the complexes completely."[785]

Not all Logical Positivists or members of the Vienna Circle were atomists, on the contrary, they regarded atomism in the sense of a supposed structure of the world as a metaphysical view, hence a view they want to get rid of. Even in Logical Atomism, although claiming ontological relevance, logical atoms of course need not to be chemical atoms. Logical Positivism and Logical Atomism were not two totally separated movements. Wittgenstein although officially no member of the Vienna Circle, at least for a time, was closely associated with that group. Moreover later the Circle engaged in intensive discussions of Wittgenstein's *Tractatus*. Although, for example, Neurath challenged the assumption of Carnap and Schlick that basic propositions must express private experience, as being inconsistent with the required intersubjectivity of science, most Logical Positivists at least epistemologically also wanted to reduce complex propositions to simple ones, to basic protocol sentences.[786]

However, early evolutionary synthesis and at least logical atomism treat their different basic building blocks as context-independent elements, as atoms, and regard their combinations essentially as unreal.

- *Positivism*: The synthetic theory of evolution is certainly a highly scientific empirical and mathematical theory. Especially in its first phase there was a strong emphasis on mathematical formulations of the Hardy-Weinberg equilibrium. For both theories atoms are connected in a mathematical way, although the apparatus of course is different – in one case formal logic, in the other probability theory.

  Moreover, the modern synthesis resembled models of *physics* (➲ above). This corresponds to the tendency of the Vienna Circle and of Logical Positivists to regard physics as the paradigmatic science. The evolutionary synthesis has also distanced itself from the more metaphysically orientated biology of the period of the 'eclipse' of Darwinism. Similarly, the philosophy of logical positivism was a revolt against the general metaphysical turmoil and the still-influential idealism.[787] If Fisher in his

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[785] L. Wittgenstein, *Tractatus Logico-Philosophicus* (1921/1922/1966), 2.0201.

[786] C.f.: M. Friedman, *Logical Positivism,* p. 793. In *Routledge Encyclopedia* (1998), Volume 5, pp. 789-795

[787] A. J. Ayer, *Philosophy in the Twentieth Century* (1982/1992), pp. 19-86. (Although Russell in his early period for example advocated a *platonic* atomism.)

> main writing[788] does nearly not quote any philosophers, not even the Logical Positivists, this, in my view, does not falsify his assumed positivist background. Logical Positivism, though also being concerned with questions of logical analyticity, to a large extent accepted and even favoured the autonomy of science.

Additionally, biotic and scientific evolution were both understood as two-step processes; the production of new mutations or theories was regarded as if they "just come from the sky", while the methods for testing them, the second step, was regarded to be "highly rigid and predetermined".➲1181

The outlined parallel, of course, has its limits. The biological and philosophical schools are in many respects utterly different, even opposed. Fisher's topics were evolution and survival, Logical Atomism and Logical Positivism were concerned with epistemological problems and the ideal of truth. Additionally, Fisher – although distancing himself from philosophy – was central in founding an ideologically engaged biologistic research programme, whereas for instance Russell, like Moore, was a proponent of an ideological disengagement of philosophy, especially a disengagement from a biologistic research programme[789].

Despite such differences, both currents in different subject areas represent a positivistic and atomistic approach, and (only) in this respect it may not only be historical contingency that Wittgenstein's *Tractatus* (the English translation in 1922) and Fisher's *On dominance ratios* (1922) were both published at a similar time.

Hence, it appears that the growth of Fisherism – despite all differences – was externally made possible not only by the existence of the new models imported from thermodynamics, but by the increasingly positivistic and atomistic conviction of the time, linked in philosophy to logical positivism and logical atomism.

(iii) Contextual Turns in Philosophy and Biology

After the Second World War analytical philosophy underwent a huge change, known as the linguistic turn, expressed in the works of Gilbert Ryle, John L. Austin, J. R. Searle and the later Wittgenstein. This tendency in analytic or now linguistic philosophy criticised the approach built on prepositional atomism and on formal logic. Still, its proponents mostly did not go the whole way back to adopting a traditional metaphysical system. The philosophy which was dominant in the English speaking world from about 1945 to 1960 dismissed its focus on the formal (logical)

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[788] R. Fisher, *The Genetical Theory of Natural Selection* (1930).

[789] G. E. Moore in his *Principia Ethica* (1903/1994) criticises the naturalistic fallacy, also of H. Spencer's Evolutionism (sections 29-35). After the World War II and "the welter of conflicting fanaticisms", a scientifically truthful approach was seen by B. Russell as one of the few unifying forces, *History of Western Philosophy* (1946/1961/1991), p. 789. Despite Moore's early ethical theory and Russell's political engagement, this general attitude of logical positivism also finally led to a neglect of normative discussions. Only recently, analytical philosophy is marked by an increasing interest in questions of morality. J. Nida-Rümelin (Ed.), *Philosophie der Gegenwart in Einzeldarstellungen von Adorno bis v. Wright* (1991), pp. XXIII-XXIV.

language and only replaced it by a focus on the ordinary language, where propositions are regarded to be highly context dependent. [790]

These developments are mirrored by aspects of the second phase of the evolutionary synthesis. Despite also shifting the emphasis to more contextuality of genes, the proponents of this phase or wing of the synthesis likewise did not return to an Aristotelian or an idealist philosophy and did not advocate notions like teleology or orthogenesis. Their approach has been closely linked with Darwinian-Mendelian population genetics. They only stressed the contextual dependence – here of genes – and, in this respect also resembling ordinary language philosophy, they put more emphasis on the 'ordinary' observations of naturalists and on the actual situation populations are found in. Although the early proponents of the second phase of the evolutionary synthesis had published their works in the late 1930s till the late 1940s, this way of thinking only gained acceptance, roughly speaking, at the end of the Second World War.[791]

> Apart from this possible influence of the changing philosophical climate in the English speaking world, obviously also many other external events may have had an impact on the second phase of the synthesis. The ideological disengagement, the acceptance of a moderate dualism and an accepted autonomy of culture presumably played a role in its own right. A fuller treatment would also need to take the developments of sociology, psychology and of society itself into account.

On the whole, there seems to have been a striking parallel development in biology and philosophy even at the time of the evolutionary synthesis, although this theory claimed to be philosophically neutral. During the eclipse of Darwinism, and then during the first and second phase of the evolutionary synthesis there are parallels first to British Idealism, then to logical positivism and ordinary language philosophy. It seems probable that this parallel is not only a mere coincidence, but is presumably due either to similar challenges in the fields or even to a direct interaction of these approaches.

5.3 Gene-Darwinism – Reductionism Generalised

A radical "gene's-eye view of Darwinism" became explicit – after the earlier partly similar Fisherism – in the 1960s[792] and gained influence from the 70s till today.

The main biological claims of sociobiology have already been worked out (➲ pp. 1 ff.). In the chapter on the internal biological history we tried to gain a deeper understanding of what I called gene-Darwinism and which I regard to be at the very heart of many approaches in sociobiology. In that chapter we also compared gene-Darwinism within biology to other Darwinian sub-paradigms (➲ pp. 138 ff.). Now the intellectual influences on gene-Darwinism external to biology will be discussed.

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[790] E.g., A. Quinton, *Analytic Philosophy* (1995), p. 30.

[791] According to E. Mayr this view reached general acceptance in about 1947, although there were still few adherents of Fisherism till the 50s, *The Growth of Biological Thought* (1982), pp. 568-569.

[792] R. Dawkins, *The Selfish Gene* (1989), p. ix.

The creative, rebellious spirit of the 1960s and 70s made it generally possible to break with traditions. In these years one not only sought for new ways to live, but also for new ways in which to interpret life scientifically. E. O. Wilson's war-cry to biologise culture, Dawkins' radicalisation of the gene's viewpoint of evolution, but also the somewhat antagonistic claims (➲ pp. 144 f.) of, for example, R. C. Lewontin would not have been possible in the conservative 1950s. Because of these extremely different tendencies, it is especially difficult to speak in this time of a predominant paradigm in the sense of a uniform *Zeitgeist* or an approach dominating biology as a whole.[793]

Soon even some biologists levelled the charge against gene-Darwinism that it is not only warranted by inner-biological support, but that it is also based on external hidden ideological or metaphysical commitments. For example Lewontin and Levins, former colleagues of Wilson at the University of Chicago, – who are also themselves not free of commitments external to biology[794] – loudly opposed gene-Darwinism and its application to man. Instead of a synthesis of sociobiology with sociology, they favoured the synthesis of population genetics with ecology. Against "the agitated background of the Vietnam War, in protest against which Lewontin resigned from the National Academy of Science, Levins and Lewontin formed the Science for the People, and later the Dialectics of Biology Group, to oppose genetic reductionism (= mechanism), atomism (= individualism), and determinism (= social and political passivity)"[795].

It is difficult to assess historically how far metaphysical or ideological reasons, external to biology, were actually central in formulating the gene-Darwinian sub-paradigm in question, because this area of the history of science is still comparatively young. I agree with Ruse that it would be too easy to argue directly, that, for example, when the white southerner Wilson talks of 'slave species' of ants he is thereby showing solidarity with the antebellum South (cf. also Darwin's *Origin*). Nevertheless – and this has also been conceded by Ruse – it has also some plausibility that despite a biological basis for such ways of speaking, describing ants as 'invaders' and 'colonisers' with 'caste systems' seems to be not completely value free. Ruse in regard of Dawkins points out that a repugnance towards religion – in this respect Dawkins differs from Wilson – from the outset may have played a role in formulating his position.[796] But even in this case it seems to me that a closer treatment would be needed to decide whether the detectable repugnance is a cause or a symptom of Dawkins' gene-Darwinism.

Still being in the wood, one cannot see it for the trees. Generally the historiography of gene-Darwinism is still too young and compared with Darwin's

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[793] Hence I have to stress once more that I use the term sub-paradigm rather with the meaning of school and only want to emphasise its abstract character, its incommensurability and its inner coherence.

[794] I do not want to deny that the criticism of Darwinism and gene-Darwinism has inevitably some cultural or ideological aspects. See e.g., M. Ruse, *Mystery of Mysteries* (1999), pp. 162-167, 142-146. However, here I focus on the external history of gene-Darwinism.

[795] D. J. Depew, B. Weber, *Darwinism Evolving* (1995), p. 375.

[796] M. Ruse, *Mystery of Mysteries* (1999), pp. 131-134, 187-191, 239.

Darwinism there is not yet an as accepted canon of literature concerning its intellectual and social history.

Despite such historiographic problems I will at least present some hypotheses of mine as to what the four main external theoretical influences on gene-Darwinism and its universal application within sociobiology may have been: firstly, – and completely uncontroversially – a direct legacy from Fisherism; secondly, a neo-romantic urge of the 1960s and 70s for interdisciplinarity; thirdly, a tide of reductionism and materialism in Anglo-American philosophy; and fourthly, further conceptual 'imports' from economics.

a) The Different Biological Legacies of the Schools of Evolutionary Biology

A continuation of existing traditions certainly played an important role for all of the currently opposed theories. Gene-Darwinism continues and radicalises Fisherism, which had been dismissed by the proponents of the second phase of the synthesis.

Contrariwise especially Gould and Lewontin, are in some respects continuing and radicalising the approach of Dobzhansky, Mayr and Wright, in their emphasis on macroevolutionary autonomy (genetic drift, founder effect) variability and heterozygote superiority. They even partly advocate concepts, linked to the notion of structural constraints, which were central to romantic biology.

Today's situation is even more heterogeneous and the proponents, for example, of orthogenesis, systems theory or modified neo-Lamarckism again have their own precursors (➲ pp. 144 f.).

> Here the Fisherian tradition, from which gene-Darwinism draws, is at least mentioned, because it is external to gene-Darwinism; all the same it is internal in respect to the history of biology as a whole. Thus these influences are discussed more extensively in the chapter on internal history of biology (➲ pp. 138 f.).

b) A Misled Neo-Romantic Aspiration for Unification and Interdisciplinarity

A force which might have influenced sociobiology, gene-Darwinism and their wide application was a (possibly misled) let us say 'romantic' aspiration for unification and interdisciplinarity, present in the new *Zeitgeist* of the 1960s and 70s.

There are of course many different ways as to how one may describe the spirit of the rebellious youth of 1960s and 70s. For example, one may argue that at this time a materialist revolt of the body and sexuality against culture took place; or, the other way round, that it was a revolt of an authentic spirituality against the materialism 'after the gold rush' of the 1950s.

> Even if we would assume that the student movement has been incarnated in the critical theory of H. Marcuse, M. Horkheimer and Th. Adorno – a blend out of Hegelian, Marxist and Freudian thoughts – things do not get much easier.

This general ambivalence appears to be mirrored by the flourishing of a wide range of directions in biology. The easiest plausible way to link these two sides, would be simply to link on the one hand gene-Darwinism, as the reductionist core of present sociobiology, to the materialistic aspect; and on the other hand the new introduction of some tenets of romantic biology to the generally rather non-materialistic aspects of that time. Such a description may be valid as a rule of thumb, but I think the mapping of these approaches could not be done as simply as this.

Here we are concerned with the external background especially of gene-Darwinism. Gene-Darwinism as we have shown is clearly a quite reductionist and materialist position,[797] but I am going to argue in the present section, that in certain ways it has also been influenced by what we may call the romantic aspects of the 1960s and 70s.

The much more obvious thesis, that gene-Darwinism is linked to reductionism and materialism, is discussed in the next section. Actually we will not discuss this tendency as an aspect of the *Zeitgeist,* because it is easier to pinpoint a parallel to the development of the academic Anglo-American mainstream philosophy of that time (➲ pp. 197).

But before, my less intuitive hypothesis will be developed that the romantic aspects of the movement of the 1960s and 70s paradoxically influenced gene-Darwinism and not only its quite diverse biological antitheses (from a strictly romantic morphological approach, to something like Lewontin's materialist approach of dialectical biology). It will become clear that the current opposition of these two directions does not need to imply a complete historical isolation of each of them. If such a view on this matter would be supported by further evidence, this would parallel the recent acknowledgement that the non-romantic mechanistic account of Darwin owed something to romantic biology (➲ pp. 163).

I will now outline how three attitudes of the movement of the 1960s and 70s resembled the metaphysical commitments we have found central for the original romantic science (➲ pp. 82 f.): i. e. an organic and not mechanistic approach, a dynamic rather than static approach to society and science, and – here of most importance – an aspiration of unification and interdisciplinarity.

(1) The movement of the 1960s and 70s, like romanticism at the turn of the 19th century, could be regarded as a revolt of feeling and freedom against the sole predominance of a mechanistic rationality. This movement was at least ambivalent towards the enlightenment, which in its positivist disenchanted form, tends to undermine its own originally liberating aspects, neglecting ethical concerns and being dominated by a cold exploitive manipulative 'instrumental rationality' (*Zweckrationalität),* which rigidly serves only self-preservation as the remaining absolute overriding goal.[798]

The 1960s and 70s aspired a more holistic or organic understanding of the world – often also inspired by East Asian religions, like Buddhism – and contrasted its own intellectual desires to the alienating, individualist and capitalist 'Western rationality'.

This aspect of the 1960s/70s rather seems to be at odds with gene-Darwinism, which even tries to treat moral behaviour in terms of mathematical formulas and

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[797] ➲ pp. 138 f., but see also pp. 255 f.

[798] M. Horkheimer, Th. W. Adorno, *Dialektik der Aufklärung* (1947/1988). This book is not a rejection of enlightenment, but it is argued that enlightenment needs to be protected and enlightened about its own inherent barbarian tendencies.

which compared to an economic school would resemble a totally unrestrained version of neo-classic economics[799]. As far as there was a holistic non-individualistic attitude in the 60s and 70s, this attitude will instead have inspired the flourishing of alternative biological movements, for example, as concerned with ecological questions (➲ pp. 144 f.).

Nevertheless, youthful opposition towards the technical sterility of the 1950s may have contributed to the setting of the sociobiological agenda. As subconscious mind or universal love were discussed in public, the darker and brighter sides of the human nature were also discussed under the new heading of 'sociobiology', which from its very start was concerned with questions of aggression, sexuality and morality. As we have seen before, neither sexual behaviour nor sexual selection was a main topic under the sober regime of the evolutionary synthesis.

(2) The political and social movement and the student rebellion optimistically hoped that everything was changing, or was at least changeable. Processions of demonstrators hoped that the relations between the sexes, between nations and between economic agents could be newly invented. The 1970s – despite a critical attitude towards mere technical progress – shared with romanticism a belief in dynamics and in social progress.

This belief was presumably one of the reasons why the biological evolutionary discourse (in all its different deviations from the orthodox), as the prototypic discourse of change, became publicly important and was extended to the social sphere. In this sense also the romantic aspirations may have set the agenda for sociobiology. Despite this, the way sociobiology and especially gene-Darwinism worked on the topics of this agenda were in contrast to the original aspirations. Sociobiology and gene-Darwinism had the very reactionary aspect of *denying* changeability and emphasising a given human nature. Moreover the evolutionary mechanism were still largely regarded as something external and eternally given. Gene-Darwinism has continued not a romantic, but mainly a mechanistic approach, which, in a lingering echo of deism and a materialistically transformed Platonism, still bases its argumentation on almost eternal material and on an eternal and external – almost God-given – force, that is selection.[800]

(3) Perhaps most crucially, the spirit of the 1960s and 70s was driven by a romantic urge to unify the separate. Generally old boundaries and borders, in politics, human relationships as well as in science, were criticised. The border of the private and the public sphere was threatened. (The private is political!) In some respects the spirit of unification went even further than during Romanticism, when it only had led to the unification of national states (➲ p. 85). The protest movement of the sixties and seventies was explicitly anti-nationalistic and was committed to the idea of international companionship and universal peace. Especially during the Vietnam War, it became a movement for universal peace against national imperialism and egoistic capitalism.

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[799] ➲ pp. 198, 236.

[800] As argued elsewhere in this work, gene-Darwinism also bears the seeds of transcending a purely externalist view of Darwinism.

Within science, this urge for unification, the aspiration to join the separate, had the consequence that more emphasis was put on interdisciplinarity. Correspondingly the strict border between cultural and natural sciences was challenged – and biology was close to this border. This border could be seen as a result of the Cartesian division of the world in *res extensa* and *res cogitans* (➲ pp. 79 f.), which then had been challenged by the romantics (➲ pp. 82 f., 95 f.). Of course also materialist and positivist approaches have, now in a clearly bottom up way, continued the programme of disciplinary unification,[801] but this quite radical, finally physicalist, programme was often carried out in a simplified way (and left no room for values etc.). Hence it has either naturally provoked criticism or problematic historical consequences.

After the Second World War a cultural compromise in the demarcation of these two realms again had become nearly universally accepted. Biology worked in a Darwinian framework, but was marked by a comparatively ideological disengagement in regard of cultural questions (➲ pp. 134 f.). Psychology and sociology regarded learning as a mechanism in its own right and human culture as a distinct strata. '*Omnis cultura ex cultura*' – whether one was a follower of a mechanistic or a holistic approach, culture was again largely regarded as a thing *sui generis*.[802] C. P. Snow (1959) referred to this – I think basically Cartesian – split of intellectual life into two polar groups, with literary intellectuals at one pole and scientists at the other as "the two cultures", with biology now on the side of the sciences. This gap between the two cultures was increasingly felt to be a "gulf of mutual incomprehension" and a cause of mutual paralysis.[803]

In the 1960s and 70s it once more became possible, probably also due to the generally romantic unifying aspirations of this time, to question this division. But in different intellectual milieus, this interdisciplinary approach led to different results. On the side of the arts the sciences have been made an object of the flourishing disciplines of cultural and intellectual history. On the side of biology interdisciplinarity led not only to a possible increase in the use of metaphors[804], but to an universalisation of biological evolutionary accounts[805] and hence – opposed to the approach of the arts – to a stronger acknowledgement of the biotic aspects of the human nature. Thus the romantic aspiration of the 1960s and 70s to join the separate

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[801] Hence scientific unification in this sense became a central objective of modern science. In physics, for example, one aims at a so-called 'general unified theory' (GUT) or a 'theory of everything' (TOE).

[802] J. Tooby, L. Cosmides, proponents of evolutionary psychology, describe this view as the 'Standard Social Science Model', *The Psychological Foundations of Culture* (1992), pp. 24-49.

[803] C. P. Snow, *The Two Cultures and A Second Look* (1959/1963), pp. 3, 4, 9, 50.

[804] Metaphorical language is normally regarded as a hallmark of romanticism. E. Richards, *The Romantic Gestation of Nature* (1990), p. 131. Although metaphors are actually generally used in science ('spin' or 'flavour' in physics or 'natural selection' in biology) for example Dawkins had the special will and gift to use metaphors ('selfish gene', 'puppet', 'vehicles', 'blind watchmaker' etc.).

[805] E.g, H. Krings, a German philosopher, mentioned the *neo-Romantic* character of a universal evolutionism which became increasingly influential during that time, *Evolution und Freiheit* (1984), p. 168.

may have also catalysed the new, finally non-romantic, rather mechanistic sociobiologist synthesis of the biotic and the cultural world.

In conclusion, the agenda of sociobiology to give an evolutionary explanation to the social (especially sexual and moral) behaviour even of humans, has plausibly been influenced by the neo-romantic aspirations of the 1960s and 70s: firstly by an interest in shedding light on the darker and brighter aspects of human life, secondly, by the goal of giving an evolutionary account of these matters and thirdly, by the aspiration to give an interdisciplinary account.

The transformation of Darwinism to gene-Darwinism, which in an atomistic way worked out (and altered) the neo-romantic agenda of a unified evolutionary explanation of the biotic and cultural world, could in my opinion only be understood, if we additionally take materialism and reductionism into account, partly present in the general spirit of the time and which clearly became dominant in philosophy.

c) 'Naturalistic Turn' – Reductionism and Materialism in Philosophy

In the 1960s and 70s analytical philosophy, especially influential in the English speaking world,[806] turned away from the semantic approach mentioned before (➲ pp. 186 f.).[807] Instead a materialist, naturalist view started to hold centre-stage.[808]

This development is especially striking for the philosophy of mind: Quine proposed a more naturalistic approach to epistemology.[809] D. M. Armstrong's *A Materialist Theory of Mind* (1968) or D. Davidson's *Mental events* (1970) influentially developed a physicalist and reductionist perspective. One might say that the eliminative materialism of the Churchlands is a recent radicalisation of the materialist approaches of that time. However, such attitudes – perhaps not always voluntarily – paved the way for a far reaching denial of inherent properties and purposes of culture also influential in sociobiology.

Within psychology as well the minimalist movement – despite a growth of alternative approaches – reached its peak in the years when gene-Darwinism started to come into full bloom. Complex intentional activities were analysed as chained sequences of atomic bits of behaviour.[810]

Reductionism, especially in philosophy and philosophy of science, presumably will not only have paralleled the reductionism in gene-atomistic Darwinism, but also may have influenced it. Gene-atomism is – according to Mayr's terminology[811] – a 'proximate' reductionism. Another even more important form of reductionism is an

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[806] In Germany, for example, analytical philosophy, although of increasing influence, was still far from being dominant even in the 1990s. This becomes clear in a guide which the author has co-published with the contributions of 200 German philosophy professors: M. v. Sydow, St. Rabanus, P. Steinfeld, *Studienführer Philosophie* (1996).

[807] Also e.g., A. Quinton, *Analytic Philosophy* (1995), p. 30.

[808] D. Cooper, *World Philosophies* (1996), pp. 459 f.

[809] W. v. Quine, *Epistemology Naturalised* (1968/1969), esp. p. 90.

[810] R. J. Richards, *Darwin and the Emergence of Evolutionary Theories of Mind and Behavior* (1987), p. 539.

[811] E. Mayr uses the terms 'proximate questions', which asks for a physiological explanation of a trait, and 'ultimate question' which asks for an evolutionary explanation.

'ultimate', here functional one, claiming that there is only one relevant existing mechanism, i. e. selection. Some present philosophers like D. C. Dennett, himself coming from philosophy of mind, take the latter view.[812]

As the reductionism of gene-Darwinism in its sociobiological application definitely had a repercussion on philosophy, sociology and ethics (➲ pp. 51 f., 207 f.), it also seems plausible that the reductionist attitude dominant in philosophy may likewise have influenced the reductionism of gene-Darwinism.

d) 'Import' of Economical Concepts – Gene-Capitalism?

Milton Friedman was awarded the Nobel price for economics in 1976, the same year Dawkins published his seminal book *The Selfish Gene.*

It is doubtful that Friedman, as ardent supporter of pure capitalism, had been directly influenced by what we have called gene-Darwinism, i. e. a gene-atomistic and germ-line-reductionist Panglossism[813]; but it is striking that both of these approaches became popular at about the same time. Leaving aside the question whether Friedman was influenced by *this* school of Darwinism especially, he was unquestionably influenced by Darwinism in general.[814] Moreover, this approach was equally combined with a very reductionist individualistic approach.

This should not indicate that Friedman himself adopted a biologistic stance: His approach did not focus on the reduction of economy to neurology, but he adopted the Darwinian *mechanism* and applied it as the natural order of economy. In this sense he could be seen as what I am going to call a 'process reductionist', advocating 'process-Darwinism', rather than as a 'substance reductionist' (➲ pp. 243 f.).

Friedman indeed adopted the notions of natural selection, competition and survival of the fittest from evolutionary biology. He believed that increased competition automatically leads to adaptation. The general belief in an overall positive result of the individual's pursuit of selfish interests, although purged of all religious and moral overtones, goes back to Adam Smith's belief in the *invisible hand* and his optimistic foundation of *laissez faire* capitalism (➲ p. 178). Friedman defended the claim of rational maximisation of profit based on the concept of natural selection. But the Panglossian belief that natural selection and competition necessarily leads to

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[812] D. C. Dennett, *Darwin's Dangerous Idea* (1995). But functionalist views, as in the case of H. Putnam, need not necessarily to result in materialism. For example, a mental state of pain can be realised on different physiological grounds. This seems to be valid even within the machine metaphor: Computer programs can (sometimes) run on different operating systems and different hardware.

[813] The notion Panglossism indicates a radical adaptionist view, either in a religious, teleological or secularised form, for example in Ch. Darwin's *Origin of Species* (1859). In Voltaire's *Candide* (1759), Dr. Pangloss states total adaptationism for teleological reasons, ➲ footnote 818.

[814] G. M. Hodgson, *Economics and Evolution* (1993), pp. 199, 201, 208 (on Friedman and Darwinism).

adaptation – also held by Darwin in his middle period[815] – has become criticised within both biology[816] and economics[817].[818]

Like Malthus, who had strongly influenced the reduction of the Poor Laws (➲ p. 180), Friedman had a strong impact on politics. As the leading protagonist of the politics of a highly competitive unrestrained market economy and the abolition of almost all government intervention, he became the counter-player to Keynesianism. In the 1980s Friedman god-fathered the economic politics of R. Reagan in the United States, M. Thatcher in Britain and A. Pinochet in Chile.

> This Friedmanian politics led in these countries to a decrease of the inflation rate, but also to an extraordinary rise in the unemployment rate and to a decline in production.[819]

Similar to Friedman's demand to abolish most state interventions, gene-Darwinians theoretically abandoned (or at least neglected) all macroevolutionary mechanisms, which had before been emphasised by the largely Darwinian evolutionary synthesis. M. Ridley, a writer in the field of sociobiology, shows how interwoven biological and economical thoughts are: "Society is composed of competing individuals as surely as markets are composed of competing merchants; the focus of economies and social theory is, and must be, the individual. Just as genes are the only things that replicate, so individuals, not societies, are the vehicles for genes."[820] If we also allow ourselves such simplifying associations between approaches in biology and economics, the evolutionary synthesis appears to be linked with a social market economy, whereas gene-Darwinism would be associated with unrestrained neo-liberal economics. Herewith I do not want to deny inner-biological necessities, but I agree with Midgley, that gene-Darwinism as an economic metaphor is "biological Thatcherism [...] celebrating evolution as a ceaseless crescendo of competition between essentially 'selfish' individual organisms"[821].

It has to be conceded that Dawkins' gene-Darwinism, unlike Darwin's individual Darwinism, argues even sub-individually. In this regard it is even more reductionistic than Darwin's Darwinism, but – although likewise arguing against any true within-group-altruism – gene-Darwinism at least in a limited phenotypic sense allows in principle the existence of unselfish behaviour. Still, its seems to me, that gene-Darwinism could metaphorically be linked to the Chicago School of Economics, because the proponents of explicit or implicit gene-Darwinism have always emphasised the

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[815] Darwin had left this tenet behind by the time he published the *Descent of Man* (1874), ➲ footnote 751.

[816] A canonical paper on this topic is: S. J. Gould, R. C. Lewontin, *The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme* (1979).

[817] See e.g., G. M. Hodgson, *Economics and Evolution* (1993).

[818] For the differences of this biological and the original economical approaches ➲ pp. 174 f.. For a general overview of different critiques of Panglossism ➲ pp. 339 and footnote 816.

[819] P.-H. Koesters, *Ökonomen verändern die Welt. Wirtschaftstheorien die unser Leben bestimmen* (1982), pp. 283-300.

[820] M. Ridley, *The Red Queen* (1993/1995), p. 11.

[821] M. Midgley, *Beast and Man* (1978/1995), p. xvi.

contrast to the 'benevolent' synthesis and they regarded the assumption of an unrestrained selfishness of organisms as a good approximation to the truth.[822]

It appears to me that gene-Darwinism in the early 1990s gained even more influence (despite the discussed parallel growth of subversive approaches), as after the end of the Cold War also the temper of the age in the West and East for a while became emphatically individualistic, egoistic and competitive.

In conclusion, Darwinism in general has not only influenced Friedman, but combined with Friedman's especially reductionist anti-interventionist approach, it indeed resembles the denial of group altruism also present in gene-Darwinism.

Besides the general parallel of Friedmanian economics and gene-Darwinism, an actual *'import' of economic language or models into biology* took place.

The language of sociobiology is interspersed with economical analogies. The originally economic concept of the division of labour has already long been imported from biology and has continuously been used in the whole tradition reaching from Darwin to also Wilson and Dawkins.[823]

Sociobiology adopts the metaphors around the notion of 'investment', which is generally used in its explanations of apparent 'altruism', i. e. kin selection and reciprocal altruism. Here the language of costs and returns is prevailing. Any parental behaviour is now called investment "which increases the probability the offspring's chance of surviving [...] at the cost of the parent's ability to invest in other offspring".[824]

Even more arresting is Dawkins' way of speaking, for example, of the 'casino' or 'stock market' of evolution.[825] Dawkins in *The Selfish Gene* takes an outspoken view of unrestrained gene capitalism in which the atomistic, egoistic genes are the only agents.

However, in later publications, Dawkins also speaks of maximising DNA as the true Darwinian "utility function", which lends itself to an economic treatment and in its result is very different from "maximizing the economic welfare of the species or population".[826] But "God's Utility function, as derived from a contemplation of the nuts and bolds of natural selection, turns out to be sadly at odds with such utopian visions" and is necessarily based on an "uncoordinated scramble for selfish gains".[827]

Moreover, specific economical *theories* were imported into biology. J. Maynard Smith embraced the mathematics of the *Theory of Games*.[828] This theory had been developed by J. v. Neumann and O. Morgenstern (1944) and as a mere mathematical theory it neutral towards different values or even political positions. Nevertheless, its

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[822] R. Dawkins, ➲ footnote 79; G. C. Williams, ➲ footnote 70.

[823] M. Ruse, *The Mysteries of Mysteries* (1999), pp. 180, 241-245.

[824] This has been the case at least since R. Trivers article *Parental investment and sexual selection* (1972), where he generalised the notion of investment as it has been used before. See e.g., K. Grammer, *Signale der Liebe* (1995/1998), pp. 45 f.

[825] R. Dawkins, *The Selfish Gene* (1976/1989). pp. 55-56.

[826] *Idem*, *River out of Eden* (1995), pp. 106-107, 118.

[827] *Ibid,* pp. 121-122.

[828] See especially: J. Maynard Smith, *Evolution and the Theory of Games* (1982).

application normally presupposes certain metaphysical commitments: especially the validity of the axiom of entity egoism has to be assumed on a certain basic level of explanation.[829]

> Maynard Smith himself has cautiously speculated about connections between his increasingly reductionist theoretical approach and his political increasingly critical attitude towards Marxism.[830]

Generally game theory is at least in its simple applications concerned with basically competitive 'games', or more generally, with conflicts.[831] A mathematical theory only can be applied if its axioms are applicable. The axiom of entity egoism, here the egoistic goal to win a game, is no doubt usually valid in cases like roulette or checkers (where the rules of the game normally make players fulfil these axioms). For gene-Darwinism, where the principle of entity egoism is assumed to work on the level of single genes, it of course appears consistent to introduce this principle on the gene-level. But this is not self evident and needs a theoretical and empirical discussion. A *cautious* application of game theory may indeed shed light even on the evolution of morals,[832] but it should be realised that supporters of the evolutionary synthesis, like E. Mayr, would, for example, not have taken the axiom of gene egoism as a default explanation. In their view the burden of proof in the unit of selection debate would rest rather on the selfish gene approach than on the population approach (➲ pp. 127 f.).

Although the incorporation of economical models has no doubt enhanced the complexity of sociobiology, still the basic question which the philosopher in particular has to pose, is whether the principles on which this edifice is build are always applicable – this means whether they are true, useful and ethical (➲ pp. 243 f.).

Sociobiology, in its radical version, claims that models of game theory can also explain *human moral* behaviour. But it is highly problematic, whether the axiom of total entity egoism – either on the level of the gene or on the level of the individual – is in particular always applicable to human *moral* behaviour. It totally neglects the fact that humans appear to be able to act morally, not only because it is from time to time also profitable, but because it is good. Game theorists may translate this into their language. 'Entity egoism' does not always have to be a valid axiom. The pay-off for humans can sometimes lie not in the maximisation of their own profit, but in being intrinsically moral, that is in following an external end in itself. Expressed in different words closer to traditional philosophy we may say, that the essence of being human –

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[829] However, without having worked on Maynard Smith's account in detail, I think that his concept of evolutionarily stable strategies may well be interpreted to transcend gene-atomism in its most austere sense; ➲ pp. 39 f.

[830] J. Maynard Smith, *Shaping Life* (1998), p. 43, 45.

[831] A. J. Jones, *Game Theory: Mathematical Modes of Conflict* (1980). (Actually Neumann and Morgenstern also treated co-operative games, but they are more complicated and are less often found in the evolutionary literature.)

[832] E.g., M. Schefczyk, *Die Evolution der Kooperation: Perspektiven und Grenzen spieltheoretischer Modelle* (1996).

which is indeed not always realised – is to live not only to survive, but to live to be good (➲ pp. 418 f.).

Whether such a critique is theoretically possible will be discussed at length in the last Part IV.

5.4 Summary: Biology as 'Geisteswissenschaft'?

In the current Chapter 5 of Part II on the external history of Darwinism, it became clear that all Darwinian sub-paradigms, we had distinguished in biological respects in Chapter 4, have also been externally influenced by the intellectual developments of their time. These influences reach from the application of theoretical tools of other disciplines, over a striking parallel to the mainstream development in philosophy, to an interaction for example with economic theories and commitments.

First, theoretical or mathematical tools had been adopted from other disciplines. For example, concepts of the 'probability revolution', partly developed in thermodynamics, with some relay had been applied to what I have called the first step and also the second step of the evolutionary synthesis. Another example would be the mathematical theory of games applied in present sociobiology.

Secondly, we have worked out that the rise and fall of the discussed Darwinian sub-paradigms has in some central respects been paralleled by the development mainstream philosophy at least in the English speaking world: Darwin's Darwinism – compared with earlier romantic or essentialist biologist – already mirrors the increasingly secularised theism of universal laws of nature dominating his time more and more and the rise of positivism, materialism and mechanicism. Moreover, his individualism could also be found in utilitarian approaches at about that time. Correspondingly the decline of Darwinism at the turn of the century is paralleled by a bloom of idealist philosophy. Another tide of a much more technical Darwinism corresponds also another tide of positivism in philosophy, now logical positivism. But above these bold parallels in the climate of philosophy and biology there are also further more detailed parallels. We have worked out that strict logical atomism in philosophy has been paralleled by Fisherism in biology. Fisherism, the first step of the evolutionary synthesis, also treated genes in a gene-pool in a very atomistic way. Because of this Mayr dubbed this school 'bean bag genetics'. As the second, final phase of the evolutionary synthesis differs from the first one mainly in its acknowledgement of genetic context and of the evolutionary importance of naturally observable groups, we analogously find the 'linguistic turn' away from propositional atomism towards ordinary contextual language in the mainstream of analytical philosophy. Gene-Darwinism in its radicalised revival of Fisherian genetic atomism is then paralleled by the increasing influence of materialism and reductionism in the philosophy of that time. Matters are not quite as simple as described here – for example, it might paradoxically be the rather romantic aspect of the 1960s and 70s which was interested in interdisciplinarity and which finally has contributed to the generalisation of the atomistic approach of Gene-Darwinism. Moreover, I only have shown general parallels of the biological or philosophical climate, without elaborating how these parallel developments actually have influenced each other.

Thirdly, we have found interactions of biological thought, in particular with economics. Darwin was influenced by Malthus and in turn has influenced economical thought. Further I think we have shown that gene-Darwinism, not only imports economic ideas and often uses economic language, but, at least as a metaphor, depicts the world in Friedmanian terms of unrestrained neo-'liberalism'.

It is difficult for a historian of science – and especially if he originally is a philosopher – to simplify these much more complex interactions in an adequate way. Although this is not the only concern of this work, I hope to have taken enough care in this chapter to substantiate the claim that in any discussion of the biological paradigms, more may be a topic of discussion than isolated biological questions.

I am the last one who would want to deny that there are inner-biological necessities and inner-biological evidence. Moreover I am fully in awe of and respect of the scientific enterprise of creating objective and culturally neutral knowledge!

But in fundamental disputes of biology and other sciences, it is not only ethical implications which have to be considered. Even in regard of the very premises of the theory in question, much more may be at stake than mere inner-biological or inner-scientific assumptions. I think we should not simply claim that all science is ideology – in its worst or best sense. In some aspects it is ideology, in others it is not. But anyone who wants to claim that a specific theory is to a certain extent based on ideological commitments firstly has to take on the painstaking work of disentangling its internal and external history, secondly has to show alternative theoretical options and thirdly has to argue why these scientific theories and their corresponding background ideologies have to be preferred.

Nevertheless, particularly in basic controversies or in phases of a scientific revolution, even science is and has to be also partly a *Geisteswissenschaft*, a cultural science, an art. With such an intention the label 'sociobiology' would indeed get a new meaning.

Based on the shown interactions with other subject areas it became apparent, that non-biological disciplines also employ Darwinian processes as theoretical core. We will in the following part embark into the search for a metaphysics of process-Darwinism build out of theories found in different subject areas.

Part III: Universal Darwinism

"Some indeed attribute our Heaven and all the worlds to chance happenings, saying that the vortex and shifting that disentangled the chaos and established the cosmic order came by chance."

Aristotle

In this part the philosophical position of Universal Darwinism will be developed. I will provide evidence for the claim that Darwinism, as special kind of Evolutionism, has already conquered many areas of the academic and popular world-view. I will explain some of the (often implicit) philosophical arguments which seem to support this approach.

In Chapter 6 I am going to outline the metaphysics, the basic conceptual structure, of Universal Darwinism. I shall distinguish two types of Universal Darwinism, Biologistic Darwinism with the prototypic example of gene-Darwinism, and Process-Darwinism, which is not biologistic but still only based on Darwinian processes.

In Chapter 7 an outline of the 'phenomenology' of universal Darwinism will be given. Actual theories from different subject areas will be described, which make an exclusive use of Darwinian Processes and which thus could be regarded as building blocks of process-Darwinism. Our historical treatment of the interrelations of Darwinism with other academic disciplines builds the basis of this systematic treatment of theories with a process-Darwinian core.

> For example trial-and-error-psychology – albeit build as a protective dike against Darwinian biologism – could be regarded as an approach built around a Darwinian process. Moreover falsificationism, a predominant theory of scientific justification, or aspects of neoliberal economic theory share structural similarities with Darwinism. The concepts of trial and error, conjecture and refutation, mutation and selection may serve as a possible basis for an ideology of universal Process Darwinism.

Since gene-Darwinism has been treated earlier as a phenomenon and as abstract theory, both chapters of this part will mainly focus on the development of process-Darwinism.

At the beginning of the third millennium after Christ the theory of the concept of the survival of the fittest, whether one follows gene-Darwinism or process-Darwinism, is almost as ubiquitous as the concept of 'God' was 1000 years ago.

The development of universal Darwinism will be a prerequisite for its partial criticism in Part IV of this work.

Chapter 6:
Darwinian Metaphysics – Biologistic and Process-Darwinism

In this chapter we are concerned with Darwinism as *metaphysics*, because, firstly, the theories in question claim relevance for many (if not all) subject areas and secondly because they are abstract and not directly affected by experience or empirical tests. They will shape the implicit premises of empirical hypotheses, but as part of a complex theoretical system they will neither be directly verified nor falsified. Nevertheless these concepts could be made the object of a rational discussion both within special sciences and within philosophy in general.

There are *two types of 'Universal Darwinism'*.[833] I am going to call them '*Biologistic* Darwinism' and (Universal) '*Process*-Darwinism'.[834]

To define these terms it is necessary to distinguish between *substances* and *processes*. This distinction mirrors not only the subject-predicate or noun-verb distinction of most languages, but is an almost ubiquitous aspect of (Western) common-sense ontology. The substance-process distinction is historically based on the traditional conceptual antagonism betweem being – defined as an antithesis of becoming (Parmenides) – and becoming – defined as an antithesis of being (Heraclitus).[835] Today this distinction is, par example, inherent in evolutionary biology on the one hand in the words 'genes' and 'species' and on the other hand in the words 'natural selection' and 'genetic drift'.

Instead of '*becoming*' I am using the specific term *process* which normally refers to *ordered* forms of becoming, because here we are interested in explanations; and explanations by definition are always concerned with some form of order.

I am using the specific term *substance* as an antonym of 'becomings', because the possible alternative general notions 'being' or 'entity' (*ens*) are in their broad sense also used to include becomings.

> Nevertheless the *term substance* carries two problems with it. Firstly substance is often understood in the sense of *essence*, which is not necessarily opposed to process but rather to *accidentia*. Indeed we may think of an *essential process*. The essential process of Darwinism, for

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[833] The term 'Universal Darwinism' is used by R. Dawkins, *Universal Darwinism* (1983) and e.g., by H. Plotkin, *Darwin Machines and the Nature of Knowledge* (1994/1995), pp. 59 ff.

[834] Within the specific area of evolutionary *epistemology* M. Bradie in *Asserting Evolutionary Epistemology* (1986) proposed a different distinction. He proposed the two classes of 'Evolutionary Epistemology of Mechanisms' and of 'Evolutionary Epistemology of Theories'. Roughly speaking the former term corresponds to Biologistic Darwinism and the latter to Process Darwinism. This distinction has been adopted e.g., by W. Bechtel, *Towards Making Evolutionary Epistemology into a Truly Naturalised Epistemology* (1990). I do introduce a different terminology, firstly, to denote specifically Darwinian approaches, secondly, not to be limited to epistemology and thirdly, because the term 'mechanism' in the present context would misleadingly refer to an approach based on processes instead to a biologistic approach..

[835] See: J. Mittelstrass, *Werden* (1996), p. 659. (➲ pp. 70 f.).

example, is natural selection. Similarly, essence traditionally implies lastingness. But processes may be lasting as well, following e. g. Newtonian physics both substances *and* processes are regarded to be eternal. Hence substance understood as essence is not always opposed to the notion of a process.

Secondly, substance in its modern meaning has a connotation associated with a materialist atomistic ontology. In this sense the substance of a table is not its 'tableness', but exclusively its *causa materialis,* its constituting matter, i. e. wood, a mixture of water and certain carbohydrates – finally its constituting elementary particles.

Here the term 'substance' should only be understood as antonym of process and therefore should imply neither an essentialist nor a materialist metaphysics. Substance should, for example, denote atoms, chairs, duck-rabbits, minds or theories, whereas gravity, natural selection or the event of running can be considered as processes or forces causing processes.

Employing the existing antagonism between being and becoming for descriptive reasons should not imply that I advocate its metaphysical truth. On the contrary, I rather sympathise with the position of process philosophy that 'an actual entity is a process'. It might turn out that the being of 'things' is identical with the being of processes and *vice versa* that the being of processes is identical with the being of things.[836] But based on the substance-process distinction we could subsequently understand biologistic Darwinism and process Darwinism more explicitly as specific Darwinian cases of two more general types of Reductionism.

Subsequently I will not distinguish between *reductionism* and '*eliminativism*'. For simplicity reasons I shall also not always distinguish between reduction of theories and reduction of entities. Reduction in the present work is normally used in the sense of what I shall call '*downward* reduction', corresponding to the intentions of the physicalist research programme (➲ pp. 245 f.).

Biologistic Darwinism is a Darwinian form of Biologism. Note the difference between *Biologistic* Darwinism and *biological* Darwinism, which does not need to deny the existence of higher ontological strata. Biologistic Darwinism is *universalised* biological Darwinism. The 'ism' in biolog*ism* implies its universalisation or the reduction of all higher ontological layers.

Hence biologism, like physicalism, advocates a certain form of '*substance reductionism*': Higher ontological levels, psychological, social and cultural entities should (proximately or ultimately[837]) be reduced to biological entities. Mental and social substances should be reduced to biotic substances. In this view our cognitive 'apparatus' is finally nothing but a physiological entity, which must have evolved solely according to the laws of biology (and physics).

Biologism is not necessarily Darwinian. We can also conceive a Lamarckian biologism, although Lamarckism more than Darwinism may tend to accept the

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[836] ➲ e.g., pp. 333, 363, 405.

[837] ➲ footnote 811.

autonomy of culture.[838] Hence Darwinian biologism does not only employ substance reductionism but also an inner-biological Darwinian process reductionism.

Process-Darwinism should only be defined by an exclusive use of Darwinian processes. Darwinian processes the other way round should not imply process-Darwinism as long as also other processes build an essential part of the ontological inventory in question. Process-Darwinism in regard of substances may employ substances on levels above biology, but each process finally has to be reducible to the Darwinian process of natural selection (➲ p. 102).

Process-Darwinism can either be used in the sense of *Universal* Process Darwinism (UPD), which denotes Process-Darwinism as world-view, or in the sense of a *Particular* Process Darwinism (PPD), which denotes Process-Darwinism – the exclusive application of Darwinian processes – in a certain subject area.

Process Darwinism is a special Darwinian case of what we may call '*Processism*' or (universal or particular) *process reductionism*. To introduce the clumsy term 'Processism' appears pardonable to me because of the analogy to the different types of substance reductionism (physicalism etc.). Processism is not concerned with the reduction of 'things' to lower ontological substances, but with the explaining of all processes by one process or one class of processes.

Besides UPD there are also other approaches which have favoured a universal process reductionism. For example dialectical approaches to philosophy either in its idealist (Hegel) or materialist (Marx) version universalise the one process of thesis, antithesis and synthesis.

Biological Darwinism – like any Darwinism – in its strict understanding always implies process-Darwinism (but not vice versa). This is the case because the essence of Darwinism itself is the exclusive usage of the *process* of natural selection.

Before discussing biologistic Darwinism and process Darwinism in detail, I shall discuss the epistemological problem of induction at the logical centre of Darwinism in general and hence of both outlined types of a Darwinian metaphysics.

6.1 The Problem of Induction – The Necessity of Blind Variation and External Elimination?

a) Darwinism Seen as Universal Principle

In a Darwinian Metaphysics – either gene-Darwinian or process-Darwinian – natural selection is often understood to be more than a quasi-physical force, it amounts to an all-powerful principle.

Such a claim can either rest on an "extrapolation" of an empirically found hierarchy of selection processes "to all knowledge processes"[839] or on logical or

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[838] The prevailing biologism of the 1920s was actually not a purely Darwinian one, but partly mixed with Lamarckian ideas. If a more romantic and Lamarckian biology would replace or modify pure Darwinism, this does not *necessarily* result in an abolition of *biologistic* attitudes towards culture.

metaphysical considerations. Examples of the empirical basis will be outlined only in the following chapter, whereas the logical argumentation linked to the problem of induction will be outlined in the next section of the present chapter. In the present section some striking examples of a universalisation of Darwinism will be documented, without treating their justification in detail.

Dawkins has claimed that Darwinism is not only empirically but theoretically "probably the only theory that *can* adequately account for phenomena that we associate with life." Other explanations are "in principle incapable of [...] explaining the evolution of organized, adaptive complexity."[840] For example Lamarckian "aquired characters are not always improvements. There is no reason why they should be, and indeed the vast majority of them are injuries." Dawkins argues in principle against instructivism and in favour of selectionism: "Even if acquired characters are inherited on some planet, evolution there will still rely on a Darwinian guide for its adaptive direction".[841]

Campbell generally argued that a Darwinian process, "a blind-variation-and-selective retention process", "is fundamental to all inductive achievements, to all genuine increases in knowledge, to all increases in fit of system to environment."[842] "Considered as improvements or solutions, none of these variations has any a priori validity." According to him "at no stage has there been any transfusion of knowledge from the outside, nor of mechanisms of knowing, nor of fundamental certainties."[843]

> Campbell concedes that there could be shortcuts of these processes. But these shortcuts are completely achieved "originally by blind variation and selective retention, and contain their own blind variation and selective retention concept on some level."[844]

These two formulations of universal Darwinism might be regarded as a cynical interpretation of the biblical text: "What has been is what will be, and [in regard of processes] there is nothing new under the sun" (Ecclesiastes, 1:9).

b) The Problem of Induction (Hume and Popper)

Although not every advocate of the outlined generalised Darwinian approach will be aware of it, these claims have a deeper and older philosophical grounding, which has to be taken seriously. Besides important empirical questions, the logical core of universal Darwinism is the proposed purely negative 'solution' to the problem of

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[839] E.g., D. T. Campbell, *Evolutionary Epistemology* (1974), p. 421. D. T. Campbell, *Blind Variation and Selective Retention in Creative Thought as in Other Knowledge Processes,* 1987 (1960), p. 111. (From the viewpoint of Universal Darwinism the term 'extrapolation' in my opinion would not be an appropriate term. ➲ pp. 209).

[840] R. Dawkins, *Universal Darwinism* (1983), pp. 403, 404.

[841] *Ibid,* p. 409, also p. 408.

[842] D. T. Campbell, *Blind Variation and Selective Retention in Creative Thought as in Other Knowledge Processes* (1960/1987), p. 91. Identical: D. T. Campbell, *Evolutionary Epistemology* (1974), p. 421.

[843] D. T. Campbell, *Evolutionary Epistemology* (1974), pp. 415, 411.

[844] *Idem*, *Evolutionary Epistemology* (1974), p. 421; *Blind Variation and Selective Retention in Creative Thought as in Other Knowledge Processes* (1960/1987), p. 91.

induction.[845] If any possibility of 'sight' is theoretically deemed to be impossible, if any possibility of induction in its broadest sense is denied, it will be shown that only blind Darwinian mechanisms remain to explore the unknown.

The problem of induction goes at least back to Hume (➲ p. 79), who realised the logical problem to warrant causal laws like any claims about unobserved instances, based on an actually finite number of observed instances. According to Hume "there can be no demonstrative arguments to prove that those instances, of which we have had no experience, resemble those, of which we have had experience."[846]

> If we would adopt an extreme Humean position and we would self-referentially apply this view to this claim itself, this claim might be also regarded as an unwarranted inductive generalisation of empirical knowledge.

Although Hume did not solve the problem of induction, generalisation or extrapolation on logical grounds, he stayed convinced that human thought and science strongly relies on induction and that we actually do and have to regard some general theories as more valid than others. This tension between missing logical justification and heuristic mental necessity of a theory of induction could be called Hume's general problem of induction.[847]

Popper restated Hume's problem of induction along the lines of simple modern formal logic. Universal (lawlike) empirical claims of knowledge, like 'all strawberries are edible', can never be completely verified on the basis of evidence, as long as not all instances, all strawberries, have been tested. There is – as almost everyone will agree – no necessity, why we should not suddenly come across a counterexample of a poisonous strawberry. But Popper goes further than this: Since induction could never have the security of deductive logic, every inductive methodology is strictly speaking not logical and hence not valid at all. Hence Popper radicalised Hume in arguing that there is no general problem of induction, because there is no induction at all. Moreover, Popper has stressed that a single counter-evidence, a poisonous strawberry, is – logically – conclusive to refute or falsify the proposition in question. Hence Popper – also inspired by biological Darwinism – concludes that scientists in a process of conjecture and refutation can and do only try to falsify laws and never try to verify them. This 'logic of discovery', which as we will see resembles a Darwinian process, was mainly worked out in the field of theory of science, but it was intended as a universal logical principle.[848]

Quine called this approach 'negative doctrine of evidence'. Evidence does not serve to support a hypothesis, but only to refute it.[849] (In our more general context we may think not only of theoretical intellectual hypotheses but also of 'biotic hypotheses', i. e. varieties of organisms.)

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[845] For other central theoretical aspects ➲ pp. 333f.

[846] D. Hume, *A Treatise of Human Nature* (1739/1740; 1888; 1978), Book I, Part III, sec. VI, p. 89.

[847] K. R. Popper distingushes Hume's logical and empirical problem of induction, *Objective Knowledge* (1972/1979), esp. 1.2, 2.26-2.29.

[848] K. R. Popper, *My Solution of Hume's Problem of Induction* (1974); *Objective Knowledge* (1972/1979), 1, 2; *Logik der Forschung* (1934/1966). (➲ pp. 232 f.).

[849] W. v. O. Quine, *On Popper's Negative Methodology* (1974), p. 218.

In my opinion the basic assumptions of thorough (universal) Darwinism can be and have to be qualified to a further extent. Following a truly negative doctrine of evidence, one would not only deny any flux of information from the external to the internal, but one would additionally deny any internal reasoning or improvement of information or, to speak in a Kantian way, any synthetic truth *a priori*. This additional precondition naturally corresponds to the actual historical opposition of this school to the Kantian concept of synthetic truth a priory. It implies two additional more radical core assumptions of (Universal) Darwinism (➲ also pp. 358 f.). A denial of any induction and internal improvement, a learning process indeed has to be a Darwinian process, which in its first variational step is *blind* and in its second eliminational step is caused *externally*. Only with this additional second justification – as far as I know, normally not formulated explicitly – radical Darwinism seems to become justified. If we face the totally new and we have to step into the dark and our guesses are necessarily blind, the corrections of our guesses will be necessarily external (➲ next section).

c) Toward a Critique of a Falsificationist Necessity of Universal Darwinism

In the current section I am not yet concerned with a full criticism of the outlined metaphysical foundation of Universal Darwinism (➲ Part IV), but I want to point out that this view has not remained unchallenged.

Kant did not only follow Hume in attacking dogmatism, but also opposed Hume's sceptical despair concerning the logical justification of causal laws. Kant favoured the rational *a priori* existence of *a principle* of causality. Moreover – in contrast to the above Darwinian metaphysics – he advocated the possibility of a (critically limited) synthetic reasonable extension of the *a priori* (or empirically) given.[850]

Within a more pronounced empiricist approach, Mill developed the inductivist Method of Agreement and Difference which had been developed earlier by Scotus, Ockham, Grosseteste and even Aristotle. But also later, within the Vienna Circle – already versed in modern formal logic –, Popper's falsificationism was challenged and stood in antithetical opposition to the influential inductivist approaches. Carnap and Reichenbach in particular advocated that hypotheses have truth probabilities, according to their positive degree of confirmation.

It is neither possible to elaborate nor to access these alternative approaches here. Instead, I want to mention some objections which have been made directly in reaction to Popper's 'negative doctrine of evidence', which in the extended outlined version could be regarded as a possible basis of a Darwinian metaphysics.

Quine, who partly shows sympathy for Popper's way of arguing, also pointed to a flaw if Popper's logical argumentation is taken as basis for a *general* negative doctrine of evidence. Quine firstly pointed out that on the grounds of deductive logic a negative doctrine of evidence is not reasonable for existential statements like 'some strawberries are edible'. On the contrary, for existential statements supportive evidence is decisive and negative evidence does contribute as little as positive evidence

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[850] I. Kant, *Kritik der reinen Vernunft.* (1781/1787), B, pp. 19 f., 127-128, 232 f, 786-797.

does in the case of universal statements. But because science is normally concerned with universal laws, he concedes that this argument might not be a refutation of a predominantly negative methodology. Secondly, Quine argued that complex propositions with multiple quantification are logically not directly falsifiable. Hence to Quine a *general* negative doctrine of evidence also becomes questionable.[851]

Putnam criticised that if there "were no suggestion at all that a law which has withstood severe tests is likely to withstand further tests", no theory would be more verified than another one, and "science would be a wholly unimportant activity". Science actually seeks for predictive power. According to Putnam, Popper could only argue the way he does, because – against Popper's own views – Popper's theory of corroboration *is* a theory of induction.[852] Similarly Lakatos argued that, understood properly, Popper's approach – albeit conjectural – implies a 'thin' metaphysical principle of induction.[853]

Secondly Putnam, in its results similar to Quine's logical second argument, urged that theories in fact are not directly falsifiable; instead of their central claims often only less central 'auxiliary sentences' become rejected.[854] Lakatos' treatment of theory development stresses that the core of a theory is protected by a belt of auxiliary sentences and hence could not directly be falsified by contradictory observations.

It is an essential feature of the argumentation of Quine, Putnam and Lakatos that in a complex situation – not limited to simple protocol sentences – a falsificationist approach is neither descriptively nor normatively the philosopher's stone.

My own criticism of universal Darwinism in the subsequent Part IV shall build on this way of arguing. Nevertheless, I want to point out here that the Darwinian critique of induction does indeed make a valid point – although may be a tautological and trivial one, which in my view is finally not at odds with inductive methodology. If newness is strictly defined as the totally unknown we will by definition not know anything at all about it. (This differs, for example, from the situation in which we are entering a dark room, where we would still at least know something about gravity and we would have the rough idea that a room has a limited seize etc.). Provided that we could think of the *totally* unknown – it almost seems to be a non-thought[855] – *any* strategy to explore it would *a priori* have the same value (this is a precondition for our understanding of the term 'unknown'), and in this sense any strategy could indeed by definition be interpreted as a process of blind variation and external elimination. That the *totally* unknown by definition could not be known in advance is true, tautological and trivial.

Although this true – if tautological – claim has too seldom been acknowledged, it is worse that this claim even is more seldom separated from a claim which, in my

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[851] W. v. O. Quine, *On Popper's Negative Methodology* (1974), pp. 218-220.

[852] H. Putnam, *The 'Corroboration' of Theories* (1974), esp. pp. 222-223.

[853] I. Lakatos, *Popper on Demarkation and Induction* (1974), pp. 256, 261.

[854] H. Putnam, *The 'Corroboration' of Theories* (1974), esp. pp. 226-237, but also see: K. R. Popper, *Putnam on 'Auxiliary Sentences', Called by Me 'Initial Conditions'* (1974).

[855] It could be argued that the totally new or unknown could in principle not be a matter of explanations, otherwise it would not be totally new or unknown. See similar: R. Spaemann, R. Isak, *Evolution ohne Ziel?* (1992), p. 154.

opinion, is indeed controversial. Although the unknown is of course by definition always unknown, the only reasonable problem of induction is whether the new, the yet unobserved, is always completely unknown and whether the apparently new always needs to be explored by the same simple blind mechanism. Is it legitimate to assume that the sun will rise tomorrow? Such questions opened the dispute on induction and inductivists only have hoped that there is a solution to such a problem. Could we legitimately claim to know something about what had not been directly observed before, could we infer from observed to unobserved instances, is it justified to generalise, to extrapolate, to synthesis or – to put it boldly – to reason in a bottom up way?If induction supports that the sun will rise tomorrow, it will – of course – never have the same degree of security as strict, deductive reasoning.[856] Although I welcome the fallibilist claim that our (scientific) knowledge always remains vulnerable, this in my opinion does not require a research programme of strict blindness and falsificationism.[857] I am going to argue that knowledge (intellectual or biological knowledge) in facing the new is neither necessarily blind nor omniscient; instead there are different degrees of sight (➲ particularly pp. 371 f.).

Following Quine's, Putnam's and Lakatos' arguments, complex systems of (biological or intellectual) knowledge do not logically need to function according to a falsificationist methodology of discovery. In the fourth part of this work I shall argue that not everything new to a theory (or to an organism) is necessarily totally unknown, in the sense that only blind trial and external elimination is the only possible mechanism to explore it. I am arguing against the view that the world on the relevant levels of explanation is *a priori* limited to the one and only search algorithm of a strictly Darwinian process. I am going to argue that guesses logically, and empirically already in the biological layer, neither need to be blind nor to be externally selected. If an organism, for example, literally has the capacity of sight, it can see new paths even if these paths have never existed before. Of course, this capacity might have evolved based on the existence of other paths in the phylogenetic history of that organism. Nevertheless it seems that generalisations (inductions) may play a crucial role even in biological evolution. The organism may also perceive streets and cars which did definitely not exist in the evolutionary history. An 'epistem-ontology' which only reduces this to old patterns (despite the importance of such an explanation) and limits itself to an inevitable blind trial-and-error process, would I think neglect this essential tendency for openness to new possibilities.

Although I conceded the above developed (tautological) principle of blindness, I think our metaphysics should stress something else: I will argue that the biological and cultural evolutionary process should rather be understood as an evolving process itself, whose rules are changing and which may partly even be changeable for us. On the relevant explanatory level there is no principle of conservation of blindness and wastefulness, but the possibility of progression towards sight. Newly evolved forces

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[856] I think it was Strawson, who argued that inductive inference is inductively valid just as deductive inference is deductively valid.

[857] It appears possible to me that both seemingly apposed positions partly may only use a different terminology and may somehow be reconcilable.

may gain some autonomy and direct evolution in a different direction. For example moral beliefs may direct human, cultural (and even biological) development into a direction which is not always opportunistically adaptive, but in accordance with religious or philosophical principles.

After developing the metaphysical background to Universal Darwinism and a sketch of my critique of this approach, we now come back to the two types of universal Darwinism, biologistic Darwinism and process-Darwinism.

6.2 Biologistic Darwinism – Gene-Darwinism as Prototype

The Darwinian paradigm of gene-Darwinism could be seen as today's most influential representative of a theory of Darwinian Biologism.[858]

Generally many of its proponents claim that psychology and social sciences should become biologised (➲ pp. 35 f.). Although this Darwinian paradigm could not yet be counted as accepted basis for all social science, it can already be detected as an assumption in a wide range of subject areas.

Gene-Darwinism is a *prototypic* reductionist theory, because, even compared with other largely Darwinian paradigms, it continues the reductionist programme in regard of substances and processes most radically.

In regard of *substance reductionism* gene-Darwinism within biology vigorously advocates the reduction of all other explanatory levels like organisms, groups, gene-pools and ecosystems to only one unit of selection. The ultimate Reality is built by single egoistic genes only. Earlier we distinguished the germ-line-reductionism and the gene-atomism inherent in such a claim (➲ pp. 139 f.).

In regard of *process reductionism* gene-Darwinism is presumably the most radical example of pure Darwinism. In contrast to Darwin's Darwinism and even to the synthetic theory, gene-Darwinism is purged from all remaining non-Darwinian aspects and advocates a minimalist Darwinian process monism (➲ pp. 142 f.). It is only natural selection, which 'drives' evolution:

First, processes especially on the level of populations, like genetic drift or founder effect, which have been emphasised by proponents of the second step of the evolutionary synthesis, are not clearly strictly Darwinian as a process of atomistic trial-and-error. These processes are clearly less emphasised by gene-Darwinism – like the level of population is in general. If these processes are not explicitly rejected, they are regarded either to be comparatively irrelevant or reducible to natural selection.

Secondly, the new processes which paradoxically have been newly advocated in the gene-Darwinian parent discipline of sociobiology, are, according to gene-Darwinism, finally reducible to natural selection. Sociobiology has distinguished new types of selection, especially kin selection and selection of reciprocal altruism (➲ pp. 36 f.). Although – as mentioned in the referred section – it might be possible to argue that these mechanisms gain some autonomy, I think that gene-Darwinism regards them as mere applications of one fundamental selection principle. Dawkins pronounces that we should move "towards giving up the term 'kin selection' as well as group selection

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[858] On gene-Darwinism and sociobiology ➲ pp. 29 f., 138 f., 191 f., 207 f.

and individual selection. Instead of all these we should substitute the single term 'replicator selection'. Evolutionary models, whether they call themselves group-selectionist or individual-selectionist, are fundamentally gene-selectionist."[859]

Thirdly, sexual selection as alternative process to natural selection has been revitalised by gene-Darwinism and sociobiology. The evolutionary synthesis, for reasons mentioned earlier, has neglected or denied its existence. I very much appreciate this revitalisation, but I think that gene-Darwinism still does not regard sexual selection as a proper *noumenon.* (a) Sexual selection is normally not understood as a new emergent process with some *autonomy*, but at most as a short-cut version of natural selection. (b) Sexual selection is not (yet) integrated into a general theory of process emergentism.

Although I indeed think that the more active understanding of the genes and even the proposed or revitalised mechanisms also bears germs for the transcendence of pure Darwinism (➲ pp. 143, 358 f.), I think gene-Darwinism both in regard of *substance reductionism* and in regard of *process reductionism,* could, at least in its own understanding, serve as a prototypic example of Darwinism.

6.3 Universal Process-Darwinism – A New Alkahest

Today, the general idea of a universal – not necessarily Darwinian – evolution is widely accepted. Nature and culture is described in an increasingly evolutionary and dynamic way.[860] Today's physics teaches us that even the structure of atoms, stars and the basic physical forces are not static, but changing, unfolding or emerging in time. Palaeontology provides us with an account of the changes of the biotic world. History tells us about the development of culture and politics. History of philosophy and history of science is concerned with the development of techniques, theories and disciplines, telling us something about the change of *nous.* Despite this unanimous appeal to evolution, different schools and disciplines strongly differ on *how* to interpret this process of evolution. [861]

Universal Process Darwinism (UPD, ➲ pp. 153 f., 207 f.) is a world-view that Darwinian Processes could provide an adequate exhaustive explanation not only for biology, but for any subject areas, where evolution occurs. This approach results in a 'nested hierarchy'[862] of Darwinian Processes.

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[859] R. Dawkins, *Replicator Selection and the Extended Phenotype* (1978), p. 62, also ➲ footnotes 99, 579.

[860] E.g., I. Prigogine, *From Being to Becoming: Time and Complexity in Physical Science* (1979). K. Gloy, *Das Verständnis der Natur* (1995), pp. 224-225. J. Götschl, *Zur philosophischen Bedeutung des Paradigmas der Selbstorganisation* (1993), pp. 66-73. G. Vollmer, *Evolutionäre Erkenntnistheorie* (1975/1990), Chapter C 'Universelle Evolution'.

[861] Like Darwinism, different philosophical, developmental or selforganisational theories likewise claim to have a quite universal scope ➲ e.g., pp. 152 f.

[862] D. T. Campbell, *Evolutionary Epistemology* (1974), pp. 419 f.; *Blind Variation and Selective Retention in Creative Thought as in Other Knowledge Processes* (1960/1987).

I define a Darwinian Process as the process of natural selection in the broad sense, which we have already identified as the conceptual core of today's Darwinism.[863] Natural selection in the broad sense is a two step process[371] of blind production of entities and their environmental elimination. This algorithm[372] has adequately been described by D. Campbell as a process of "blind-variation-and-selective-retention".[864]

> This definition of a Darwinian process may need further clarification. What does 'blindness' and 'selective retention' mean? To build up a position worth attacking, we will once more examine and clarify this definition (➲ p. 333).

Particular theories of Process Darwinism have actually not only been proposed for biological evolution but also, for example, for the immune system, for operant conditioning, for the selection of theories and even in economics (➲ pp. 221 f.). Here Darwinian Processes are dominating particular subject areas.

Both as a collection of theories and as a general approach, process Darwinism has gained influence. Important steps towards UPD have been made by Campbell, Hull, Dennett and, in a way also, by Dawkins, who radicalised the biological discussion as well as contributing to a two level process Darwinism of atomistic genes and memes.[865] Lewontin's notion of the unit of selection, though himself rather critical of an exclusively Darwinian metaphysics, has also contributed to the flourishing of this school.[866] Other proponents of UPD are, for example, H. Plotkin[867] and, in some respects, P. Munz.[868]

As already mentioned UPD is defined by its Darwinian process reductionism. The concept of Darwinian Processes is regarded to be the 'alkahest' – the alchemists' universal solvent. '*Dennett's* dangerous idea' appears to be a prototype of an abundant application of Darwinian Processes as well as of the reduction of all processes to Darwinian ones. Though Dennett told me in a personal discussion that he would not interpret his position as radical process reductionism, I would still hold that his book *Darwin's Dangerous Idea* has to be seen as a prototypic example for process reductionism (in type, not in token).[869] According to Dennett the Darwinian

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[863] For our working definition of Darwinism ➲ p. 102, esp. footnote 370. Correspondingly Darwin himself was not a strict 'Darwinian', ➲ pp. 106 ff.

[864] D. T. Campbell, *Epistemological Roles for Selection Theory* (1990), p. 7.

[865] ➲ pp. 57 f.

[866] ➲ pp. 153 f..

[867] H. Plotkin, *Darwin Machines and the Nature of Knowledge* (1994/1995).

[868] P. Munz, *Philosophical Darwinism: On the Origin of Knowledge by Means of Natural Selection* (1993), pp. 144, 153, but pp. 167, 169.

[869] Dennett and I had a longer discussion in a train to London, after he had given a talk at the conference of the Royal Institute of Philosophy at Reading in 1996. Drawing the parallel between processes and objects I argued in favour of something like process emergentism (➲ pp. 333 f.). Although he denied thorough process reductionism, he was also critical of process emergentism. I would interpret in hindsight that he – maybe surprisingly – was not convinced of thorough substance reductionism and advocated that Darwinian processes – despite being critical of group selection – indeed took place on different levels. Nevertheless, he did argue in favour of what I call process reductionism, i. e. the reduction to one *type* of process.

algorithm could be seen as universal acid which eats through all traditional concepts, including religion.[870] The algorithm could be applied to everything; "all exist as fruits of a single tree, the Tree of Life, and the processes that have produced each and every one of them are, at bottom, the same." Dennett concludes, on the last page of *Darwin's Dangerous Idea*, that there "is no denying, at this point, that Darwin's idea is a universal solvent, capable of cutting right to the heart of everything in sight."[871]

As physicalism claims that all *entities* (*substances* in contrast to processes) could finally be completely reduced to elementary particles, or as gene-Darwinism claims that all biological or even cultural 'substances' could be reduced to the action of selfish genes, process-Darwinism claims that all evolutionary *processes* – biological and cultural – could be reduced to the ultimate processual unit of natural selection. The Creator had been as lazy as could be imagined. According to the metaphysics of Process Darwinism natural selection is the unchangeable processual atom of evolution, and all other evolutionary processes in essence are nothing but these processual atoms (➲ pp. 209 f.).

Dawkins has contributed the general notion of a *replicator* to this approach, which he claims to be central to any process of natural selection. Dawkins has abstracted the logical essence of 'genes' and generalised it (although Dawkins within biology remained a gene-Darwinian). Replicators are "any entity in the universe which interacts [...] in such a way that copies of itself are made"[872].

I also think, perhaps even more strongly than Dawkins, that the notion of a replicator could be regarded to be a unifying central notion of Darwinism. (Although I differ from Dawkins in thinking that this notion also points beyond Darwinism. For details ➲ also pp. 257 f.)

(1) The concept *replicator* somehow leads to the concept of a evolutionary line of replicating entities and slightly changed entities. The notion of an evolutionary line is not new and other proponents of UPD have claimed that this is a necessary component of a Darwinian process (besides blind variation and 'natural' elimination).[873] But from this it can be concluded that drops of water and planets are excluded from being objects of Darwinian processes, because it would be difficult to define what an evolutionary line based on replication should be. This is the case although drops of water and planets may vary and be selected and even evolve according to some law of nature.

> Drops of water and planets may even lawfully increase or decrease in number. Still it is difficult to think of them being copied. I will agree that copying is an important emerging property. However, a certain kind of evolution seems to be excluded by this definition, which on 'higher' evolutionary levels may also wrongly be ignored.

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[870] D. Dennett, *Darwin's Dangerous Idea* (1995), pp. 61 ff.; *Es geht auch ohne Gott und Geist: Darwins ätzende Idee zerfrißt die letzten Mythen* (1996). Cf. D. Dennett, *Breaking the Spell* (2006).

[871] D. Dennett, *Darwin's Dangerous Idea* (1995), pp. 63 f., 511, 521.

[872] R. Dawkins, *Replicator Selection and the Extended Phenotype* (1978), p. 67.

[873] E.g., D. H. Campbell, *Evolutionary Epistemology* (1974), p. 421; *Blind Variation and Selective Retention in Creative Thought as in Other Knowledge Processes* (1960/1987), p. 92.

(2) The notion replicator (almost) entails the two other normally acknowledged features of a Darwinian processes, blind variation and natural elimination (➲ pp. 257 f.). "In practice no replication process is infallible, and defects in a replicator will tend to be passed on to descendants."[874] Differential elimination of these varying entities even under simplest circumstances seems to follow.

> I think that the notion of a replicator indeed could serve to conceptually unify all three components of a Darwinian Process. Simple replicators may imply natural selection. Natural selection may even imply replicators. But I am going to argue that there is the possibility that new more complex replicators have come into being which are linked to less wasteful mechanisms, which for reasons of clarity should not be called Darwinian Processes.

(3) The concept of a replicator, at least in Dawkins' works, is closely connected with an assumed ontological primacy of replicators. In the biological context this is expressed in his germ-line reductionism, the claim that selfish genes (in his view the sole replicators) have exclusive evolutionary reality whereas phenotypes, like organisms or groups, are only their ephemeral and epiphenomenal vehicles[875].

David Hull in his early writings took a rather 'organicist' or 'holist' stance and opposed the radical *substance reductionism* of gene-Darwinism. Together with Michael Ghiselin he has even vindicated the existence of species as individual wholes or – for short – as 'individuals'.[876] They proposed that species are no mere (subjective) categories with members, but rather individuals with parts.

Nevertheless, in an irony of history, Hull seems to have become an ardent supporter of *Darwinian process reductionism*. Extending the unit of selection argument to other entities than atomistic genes, it paradoxically was he, who gave respectability for a larger audience to the claim that all evolutionary processes are Darwinian processes.

Hull distinguished two classes of evolutionary entities, *replicators* and *interactors*. Thereby he adopted the notion of a replicator and also the genotype-phenotype distinction from Dawkins' replicator-vehicle distinction (which in turn could be regarded as a materialist reformulation of the Platonic distinction of *mundus intelligibilis* and its expression in the recognisable *mundus sensibilis*). Hull, replacing the term 'vehicle' by the term 'interactor', still appears to struggle against an epiphenomenal understanding of what Dawkins called vehicles. According to Hull there are *two* units of *evolution*, one unit of replication and one unit of interaction. Whereas the replicators, are the exclusively information carrying entities which form lineages, the interactors are units which are interacting and which are selected by the external environment. [877]

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[874] R. Dawkins, *Replicator Selection and the Extended Phenotype* (1978), p. 67.

[875] R. Dawkins, *The Selfish Gene* (1976/1989), pp. 15-20, also e.g., ➲ footnote 977. Dawkins later extended his concept of a vehicle, *The Extended Phenotype* (1982/1989).

[876] M. Ruse, *David Hull through Two Decades* (1989), pp. 3-4, 8, 12. M. T. Ghiselin, *A Radical Solution to the Species Problem* (1974). D. Hull, *Individuality and Selection* (1980).

[877] D. Hull, *Individuality and Selection* (1980); *Units of Evolution: A Metaphysical Essay* (1981). (Hull still often uses 'units of selection' for 'units of evolution'. This might be due to the different narrow and broad meanings of 'selection' ➲ pp. 102 f.)

New questions arise: How far is an interactor truly differing from a vehicle? Do we have to opt either for vehicles or interactors in general, or is this a domain-specific question? Although Hull's position appears very Darwinian in style, it is questionable whether his replicator-interactor position should be regarded to be as neo-Darwinian as Dawkins' replicator-vehicle position is.

In the following chapter we will discuss particular theories of Process Darwinism especially in the fields of psychology and theory of science, which might be incorporated into larger Darwinian phalanx.

> UPD results in a world-view, where genes, organisms, humans, ideas and companies are all at war and fighting for survival. It is a radicalisation of Hobbes' *homo hominem lupus est*. In the fourth part of this work, it will be worked out, why such a view, despite its simplistic appeal – at least as an exclusive and complete world-view – becomes self-contradictory.

Chapter 7:
Process-Darwinism in Particular Subject Areas

7.1 Darwinian Epistemologies and Darwinian Philosophies of Science

a) Darwinian Biological Epistemology and Darwinian Process Epistemology

The two general types of Universal Darwinism, (Universal) Biologistic Darwinism and Universal Process Darwinism, could presumably best be exemplified in the areas of epistemology or psychology, where both analogous classes of a Darwinian Biological Epistemology and a Darwinian Process Epistemology are especially apparent.[878]

> *Epistemology*, as opposed to ontology starts its investigation not directly with the question 'what is the case' but indirectly with the question 'what can we know'. Nevertheless, epistemology has always more or less directly interacted with ontology.

A *Darwinian Epistemology* can either be grounded on the conception that our percipient and mental capacities are massively moulded by Darwinian biological evolution, or could be based on the application of Darwinian process not only within biology but also in regard of trials, thoughts and theories.

'Darwinian Epistemology' should not be conflated with '*Evolutionary Epistemology*'. Although the term Evolutionary Epistemology – with its pleasing alliteration – has been made popular predominantly by Darwinian thinkers,[879] it would be inadequate to equate Evolutionary Epistemology exclusively with Darwinian Epistemology:

> Evolutionary Epistemology firstly could be understood as an epistemology which puts emphasis on how the biological or historical situation came into being. Being is understood based on its becoming; diachronic understanding sheds light on synchronic understanding. In this sense the antonym of evolutionary epistemology would be systematic epistemology. In this interpretation Evolutionary Epistemologies need not to be Darwinian but could also be Lamarckian, Hegelian etc.
>
> Secondly, the term 'evolution' especially in a philosophical work could be understood in its traditional sense, meaning the unfolding of a preformed potential structure, interpreting the whole nature by the metaphor of embryological development. In this sense evolutionary epistemology would almost be an antithesis of Darwinian Epistemology (➲ pp. 82)!
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> Thirdly, Evolutionary Epistemology could simply refer to the 'fact' of biological evolution. As long as there is dispute about the mechanisms and interpretation of biological evolution this understanding need not to be synonymous with Darwinian biological epistemology. The premiss of biological pan-Darwinism is neither an obvious logical necessity nor favoured in this work.

A generally biologically inspired approach to epistemology is not new (whether directly biological or only adopting biological processes). Particularly since Darwin a number of important thinkers, like Baldwin, Bergson, T. H. Huxley, James, Mach, Peirce, Poincaré, Simmel, Spencer and von Uexküll have contributed to such an

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[878] On M. Bradie's terminology, ➲ footnote 834.

[879] D. T. Campbell, *Evolutionary Epistemology* (1974). G. Vollmer *Evolutionäre Erkenntnistheorie* (1976).

epistemology; but according to Campbell most of these approaches kept a critical distance from a purely Darwinian epistemology.[880] Under closer scrutiny I think it may even turn out that some of the apparent advocates of a Darwinian Epistemology are also not appropriately labelled as *pure* Darwinians.

We are now going to outline the classes of *Darwinian Biological Epistemology* and *Darwinian Process Epistemology.*

Darwinian Biological Epistemology is a discipline or an approach which explains questions concerning epistemology by referring to the biotic stratum which is in turn understood in a Darwinian way. For the moment we leave the Darwinian aspect of such an epistemology aside. The term 'biological' in Biological Epistemology can be understood in a twofold way, either it could specify the *part* of epistemology which is meant (thereby accepting other aspects or approaches), or it could be an *exclusive characterisation* of epistemology (thereby excluding, for example, transcendental or sociological epistemology).

Biological epistemology, understood as a part of epistemology, appears to me to be the legitimate discipline. One may object that it is generally a more valuable task to seek other explanations, for instance, to unveil a securer aprioric foundation of knowledge, to take subjective phenomena as true starting points, or to investigate the social construction of knowledge. I think, as long as (*prima facie*) such epistemologies are also accepted and as long as we also keep a critical distance from biological 'facts', an acknowledgement of our biological nature is an essential part of epistemology – even if it turned out that this human nature is a *tabula rasa.*

Biological epistemology, understood as biological characterisation of epistemology, is a sort of biologism, which, of course, is disputable. If biologistic epistemology is also Darwinian this results in a full sub-theory of the already discussed Biologistic Darwinism. Since some sociobiologists have claimed that ethics should become biologised, the biologization of epistemology is advocated. In its purely Darwinian version this would imply that all our mental and epistemic capacities (like our visual cortex etc.) are explainable by their evolution by natural selection. In such a view even "language is no different from other complex abilities such as echolocation and stereopsis" and "the only way to explain the origin of such abilities is through the theory of natural selection." [881]

Like evolutionary theory in general, Darwinian biological epistemology has often wrongly been conceived as being monolithic. But authors actually vary considerably in their evolutionary assumptions and how far their position could be called biologistic and Darwinian. Although most authors of a biological epistemology definitely advocate at least a *partly* Darwinian position, even most founders of the discipline have not been as purely Darwinian as today's gene-Darwinians are (➲ pp. 142).

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[880] D. T. Campbell, *Evolutionary Epistemology* (1974), pp. 437-441.

[881] St. Pinker, P. Bloom, *Natural Language and Natural Selection* (1990), p. 708, quoted in D. Dennett, *Darwin's Dangerous Idea* (1995), pp. 384 ff.

Instead of developing their epistemological position I will mention their position in regard of evolutionary theory.

Biological epistemology has a long history, at least reaching back to the pre-Darwinian schools of evolutionism. Darwin – no pure Darwinian in its today's definition – also contributed to this field. Important steps to an at least partly Darwinian Biological Epistemology have been made by K. Lorenz. He even contributed to a generalisation of selection theory.[882] However, it should be noted that Lorenz in many respects also took an opposed position to today's radical gene-Darwinian view (➲ pp. 134 f., 152 f.).

Biological epistemology, then, has been elaborated especially by the philosopher and physicist G. Vollmer in *Evolutionäre Erkenntnistheorie* (1976) and in *Was können wir wissen?* (1988). Vollmer favoured hypothetical realism. In regard of the employed evolutionary theory Vollmer was sympathetic towards the 'valid', and actually moderate, Darwinism of the evolutionary synthesis.[883] However, it seems to me that Vollmer in this early writings was not so much concerned with the differences between more or less Darwinian paradigms, but more generally tried to argue and exemplify that our epistemological capacities have evolved and hence should be made object of an evolutionary (biological) epistemology. Although Vollmer adopted the 'valid' evolutionary theory, he conceded its incompleteness.[884]

Another now classical book on biological epistemology is R. Riedl's *Biologie der Erkenntnis* (1979). Riedl was also orientated towards the synthetic theory, which he regards as 'no doubt completely valid' but still also incomplete.[885] Riedl, like, for example, Wuketits, advocates a moderate systems theoretical extension of the synthetic theory (➲ pp. 152).

Maturana and Varela have also on system theoretical grounds in *El árbor del concocimiento* (1984) rather stressed their opposition to the Darwinian assumption of an externally given environment to which organisms are adapting. Their epistemology instead proposes a radical constructivism of organism and environment.

J. Barkow's, L. Cosmides' and J. Tooby's anthology *The Adapted Mind* (1992) is a landmark for the reintroduction of biological evolution to psychology and for providing empirical evidence for this approach. Tooby and Cosmides argued that explanations of biological evolution had been ignored because of the exclusive dominance of cultural explanations in a 'Standard Social Science Model'.[886] The anthology mainly adopt Darwinian explanations at the gene level. This is also the case

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[882] K. Lorenz, *Die Rückseite des Spiegels: Versuch einer Naturgeschichte menschlichen Erkennens* (1973), p. 294.

[883] G. Vollmer, *Evolutionäre Erkenntnistheorie* (1976), pp. 58, 64; *Was können wir wissen? Beiträge zur Evolutionären Erkenntnistheorie;* Band 1. *Die Natur der Erkenntnis.* Band 2. *Die Erkenntnis der Natur* (1988), e.g. Bd. 2, p. 4.

[884] G. Vollmer, *Was können wir wissen?* (1988), Bd. 2, pp. 1-38. But see E. Voland's *Moral durch Manipulation? Ein evolutionäres Szenario* (1996). G. Vollmer, *Möglichkeiten und Grenzen einer evolutionären Ethik* (1993), esp. pp. 122, 125-126, but p. 112.

[885] R. Riedl, *Strategie der Genesis* (1976/1984), p. 27.

[886] J. Tooby, L. Cosmides, *The Psychological Foundations of Culture* (1992).

for Cosmides' and Tooby's own theory of human rationality[887], which was subsequently radicalised by Gigerenzer.[888] They provided experimental evidence that participants were not able to test hypothesis in a logical way. Instead they interpreted their evidence that participants were only adapted to check for cheaters of reciprocial social contracts, as long as participants fears a potential personal disadvantage for themselves. This elicited a debate and other authors have argued that the rationality of humans in the testing of rules may indeed go beyond propositional logic, but that the testing of social rules is nonetheless highly systematic and not necessarily only at the service of personal interests, involving processes of cheater and co-operator detection as well as the use of a deontic logic.[889]

In any case, there is no monolithic phalanx of evolutionary psychologists, but a developing field which is rapidly changing. It should be noted that even Cosmides and Tooby, in some writings actually opposed the strict reductionism of gene-Darwinism.[890] More recently, Gigerenzer, who continues to advocate an evolutionary based ecological notion of rationality, seem to have turned against a pan-adaptationist view of evolution, which may indeed be difficult to bring in line with his theory of a cognitive toolbox of simple heuristics.[891]

The linguist N. Chomsky is also often wrongly conceived to be an advocate of a radically Darwinian biologistic epistemology because he has proposed that the ability to develop a universal generative grammar is due to an innate disposition. It should be noted that Chomsky himself maintains critical distance from the ultra-Darwinian camp.[892]

In my opinion an acknowledgement of a biological *basis* of our nature and our embodied knowledge is definitely a merit. But evolutionary approaches are by far not as unified as they are often supposed to be. Moreover, to replace the 'Standard Social Science Model', ignoring biology, with a 'Standard Biologistic Science Model', ignoring culture, would be no proper alternative. Hence, nothing less is at stake than human nature and the role of its second nature, culture.

Some cases of a biological epistemology seem uncontroversial. For example the range of electromagnetic waves which our eye could recognise, roughly corresponds to the range of light rays passing through the atmosphere.[893] Nevertheless, please note that even the interpretation of a prototypical and simple example, like this one, is far from trivial:

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[887] L. Cosmides, J. Tooby, *Cognitive Adaptations for Social Exchange* (1992).

[888] G. Gigerenzer, K. Hug, *Domain-Specific Reasoning* (1992). Cf. G. Gigerenzer, *Rationality for Mortals: How People Cope with Uncertainty* (2008).

[889] M. v. Sydow, *Towards a Flexible Bayesian and Deontic Logic of Testing Descriptive and Prescriptive Rules* (2006). M. v. Sydow, Y. Hagmayer, *Deontic Logic and Deontic Goals in the Wason Selection Task* (2006).

[890] J. Horgan, *Die neuen Sozialdarwinisten* (1985), pp. 82, 86.

[891] G. Gigerenzer, *Rationality for Mortals: How People Cope with Uncertainty* (2008).

[892] D. Dennett, *Darwin's Dangerous Idea* (1995), Chapter 'Chomsky contra Darwin'.

[893] G. Vollmer, *Evolutionäre Erkenntnistheorie* (1976), pp. 45-49, 97-100. H. v. Ditfurth, *Im Anfang war der Wasserstoff* (1972/1981), pp. 97-101, Figure 7.

> The correspondence of visual receptivity and atmospheric window seems to be most easily explainable by an adaptationist epistemology and in turn seems to support a Darwinian view. Such a result would not contradict my position developed later, because I will not turn against any Darwinian explanation, but against pan-Darwinism.
>
> Firstly, although adaptation to an external environment is necessary defining characteristic of Darwinism, it is not a sufficient one. Adaptation was also advocated by utterly different authors, like Paley and Lamarck. Even if we accept that their approaches are no more viable today, does this imply that Darwinism remains as only option? If our evolutionary theory advocated a less blind evolution – and in at least in this respect rather resembled Lamarckism, without adopting the Lamarkian mechanism – then, I think, it would be inappropriate to call this a Darwinian theory (➲ pp. 358 f.).
>
> Secondly, even for example given, it could be questioned whether the environment is *externally* given, a second defining characteristic of Darwinian adaptation. For example bees are receptive to a range of higher frequent electromagnetic waves, seeing no 'red' but additionally 'ultraviolet' light.
>
> Thirdly, biology may develop an improved definition of Darwinism to distinguish between more or less Darwinian sub-paradigms (➲ pp. 358 f.). The fitting between atmospheric window and the receptivity of most animals, does not directly decide whether we should advocate group or gene selection, saltational (punctuated) or gradual evolution. If these theories are not all equally Darwinian, then the given example does not imply a purely Darwinian paradigm.

For the philosophical debate it seems relevant if one may equate ideas *a priori,* advocated from Plato to Kant, simply with innate ideas. If this would be the case, Darwin would rehabilitate Plato, while he would degrade Locke. By advocating this interpretation, Darwinian and other schools of biological epistemology take aspects of transcendental and sociological epistemology by storm. Haeckel explicitly interpreted the *a priori* of Kant in the sense of innateness, Lorenz later made this claim famous and many authors have followed in their footsteps.[894] Whoever is right, it should be clear that such an interpretation is not in accordance with the intentions of Kant himself. Kant in the *Critique of pure Reason* explicitly argued that concepts *a priori* are not simply innate concepts, but – independent of whether they are inherited or learned – they are logically necessary preconditions for understanding.[895]

Darwinian Process Epistemology is the other sub-class of Darwinian Epistemology. Based on process Darwinism the *ontological inventory* of this sub-class is not limited to biological entities (substances). Instead this approach applies Darwinian processes to objects of higher ontological strata. Nonetheless, in regard of processes this epistemology remains confined to Darwinian processes.

Despite differences in emphasis as to what entities should actually be regarded as being real, there is a consensus among this approach that there are roughly at least three ontological strata where Darwinian processes do work.[896]

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[894] K. Lorenz, *Kants Lehre vom Apriorischen im Lichte gegenwärtiger Biologie* (1941), p. 99. G. Vollmer, *Evolutionäre Erkenntnistheorie* (1975), pp. 91, 126-31. P. Munz, *Philosophical Darwinism* (1993), pp. 151-153.

[895] I. Kant, *Kritik der reinen Vernunft* (1781/1787), B, pp. 167-168.

[896] Similar: H. Plotkin, *Darwin Machines and the Nature of Knowledge* (1994).

First, Darwinian processes are working within the biotic layer. From an orthodox viewpoint Darwinian processes are the only evolutionary mechanisms in this layer. In this respect, Darwinian Process Epistemology is identical with Darwinian *Biological* Epistemology. Inner-biological multi-level-Darwinism (➲ pp. 153 f.) seems also in line with Process Darwinism, and – although it is at odds with pure gene-Darwinism – it can occur as a case of biological Darwinism.

Secondly, it has been argued that Darwinian processes were working within the individual psychological stratum and could even provide an *exclusive* explanation for the heterogeneous mental and behavioural phenomena. Donald T. Campbell, based on the older theory of operant conditioning, elaborated that, for example, creativity, pattern recognition and visual perception could all be understood solely on the basis of Darwinian processes. Later on he also integrated these approaches with a Darwinian approach of theory development into a generalised selection theory.[897]

Thirdly, it has been claimed that Darwinian processes also were working in the cultural stratum, based on to the evolution of *logoi* or *memes*, like words or poems, thoughts and theories (➲ pp. 57 f.). Dawkins has proposed memes as general atomistic units of the Darwinian evolution in the cultural sphere. In the field of theory development other earlier and more elaborated proposals have been made. Already T. H. Huxley's and E. Mach's views on theory development were affected by Darwinism. More recently it was especially Popper and, to some extent, S. Toulmin who have elaborated a Darwinian theory of theory development.[898]

> Kuhn is also sometimes discussed in an evolutionary context and he seems to share with Darwinism that there could be no absolute progress, since he regards different paradigms to be incommensurable. Nevertheless Kuhn should not be regarded to be a Darwinian, since his view of theory development is essentially not gradualist but salutatorian.

These approaches, as seen already, became more and more integrated into a general theory of process-selection. As epistemology it has been stressed that all these processes are processes of knowledge acquisition. Often neglected, even the economic concept of competition – sometimes interpreted as resembling a Darwinian process – has been understood as a discovery procedure.[899] All biological, psychological and cultural evolutionary phenomena should be explainable as a learning process of blind-variation-and-selective-retention. As evolution is regarded as a process of exploring possibilities, as a process of learning, first in the biotic, then in the mental and the cultural sphere, Darwinian Process Epistemology more than other epistemologies is conflated with ontology. Ontogeny in its broadest sense *is* knowledge acquisition. Ontology *is* Epistemology and vice versa.

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[897] D. T. Campbell, *Adaptive Behaviour from Random Response* (1956); *Evolutionary Epistemology* (1974); *Blind Variation and Selective Retention in Creative Thought as in Other Knowledge Processes* (1960/1987); *Epistemological Roles for Selection Theory* (1990).

[898] St. Toulmin, *Human Understanding* (1974), pp. 394-406. (➲ pp. 232, especially on Popper).

[899] F. A. Hayek, *Competition as a Discovery Procedure* (1968/1978). Hayek even mentions 'a trial and error' process of 'cultural selection', *The Atavism of Social Justice* (1976/1978), p. 67. In general ➲ pp. 236 f.

In my opinion such an argumentation could be taken as an example for a tendency of Darwinism to undermine and transcend its own materialistic roots. Here process Darwinism suddenly looses it affinity to traditional mechanistic materialism and rather resembles a neo-Platonic, a Christian or a Schellingian idealism, where nature is understood as a process of 'intellectual' unfolding. As will afterwards appear, I share a view of evolution as intellectual process. Correspondingly, how the epistemological problem of induction may bear on ontological questions is discussed. Nevertheless, I will also stresses the differences of ontological strata and an unfolding of the process of unfolding itself. Darwinian processes, although important concepts, in my approach are not understood as the final solution to our theory of knowledge.

> Nevertheless an equation of ontology and epistemology raises fundamental problems. This is especially the case in a Darwinian framework, where biological, psychological or cultural knowledge *is* a Darwinian adaptation and blind adaptation to an external environment *is* knowledge. Such an approach would tend to dismiss anything which does not aim at short-term survival, but at sustainable survival because short-sightedness is a defining aspect of Darwinism. Moreover, if survival is made the only yardstick moral and aesthetic reasons would not be appreciated as autonomous as they should be. A position with such inclinations is I think neither true nor – to formulate it in a self-refuting way – adaptive. Finally, we should not forget the disastrous example of the Nazis, who claimed that everything is true which is adaptive for the race, justifying an anti-intellectual and anti-religious attitude and a racist selection programme. Hence, I think that if epistemology and ontology are equated, the further characterisation of such an 'epistemontology' would be vital.

In the following sub-sections two prototypic examples of Darwinian Process Epistemology will be elaborated. One is in the psychological and one in the cultural area that is operant conditioning and Popper's falsificationism. As we have seen already and as we will see in the next section there are also other ways how Darwinism has been applied in different subject areas.[900] There is not only a complex unit of selection debate in biology, but also one in process-Darwinian branches of psychology and of cultural science.

However, the chosen examples were influential and have preceded the general formulation of Process Darwinism by Campbell, Dawkins, Hull and Dennett. Both treatments show a different irony of history: Behaviourism, though built as a bulwark against biologism, paradoxically adopted Darwinian processes as central mechanisms. Popper advocated an actually Darwinian theory of falsification and was led by this very theory to attack Darwinism.

b) Operant Conditioning – Learning as Darwinian Process?

The conception of trial-and-error learning was introduced into psychology by Edward Lee Thorndike (1874-1949) and was later continued under the label of operant (or instrumental) conditioning, which was particularly promoted by the American psychologist Burrhus Frederic Skinner (1904-90). Operant conditioning, together with classical conditioning, formed the theoretical core of psychology and behaviour

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[900] For different psychological applications of Darwinian processes see: D. T. Campbell, *Evolutionary Epistemology*, (1974).

therapy during the second wave of psychological behaviourism from after World War II to the early 1970s. To achieve a further theoretical unification it was even considered whether classical conditioning, as second pillar of the behaviourist theory of learning, could at least partly be understood as being reducible to operant conditioning.[901] Provided that there are no additional 'higher' processes of learning, such a reduction would imply that trial-and-error psychology would not only be one of many legitimate psychological theories, but only the very core of the psychology of learning and hence of psychology as whole.

In the present section I want to point out three parallels between trial-and-error-psychology and Darwinism. Firstly, the mechanisms proposed are strikingly similar. Secondly, both schools are in a similar respect tautological. Finally, I should suggest and subsequently develop, that biology in its future course might – despite all differences – take a historical turn as psychology has, replacing a mere trial-and-error theory by more complex mechanisms of learning.

(1) Behaviourism not only rejected the flourishing biologistic instinct theories but paradoxically also established a theory which in regard of processes could justly be called a 'Darwinian' theory.[902]

The metaphysical or methodological confinement to behaviour forbade the flourishing speculations of philosophical schools and psychoanalyses as of physiological and instinct theories,[903] around the turn of the century. A rigorous or even rigid scientific standard was established which made it possible to show that based on trial-and-error learning even animals like dogs, pigeons and rats were not completely driven by instincts, but could to a large extent modify their behaviour due to a given environment. But as behaviourism restricted itself only to the external, i. e. directly observable behaviour in a given situation, the internal became neglected. In principle any first person account was excluded. Moreover, although operant conditioning complemented classical 'respondent' conditioning and hence seemingly was concerned with a more active aspect of behaviour, this theory was still placed within the behaviourist framework of the 'empty organism' and was actually limited to simple, rather passive processes.[904] Despite advanced experimental designs the construction of more complex inner mechanisms, whether inherited or learned, actually became neglected. The only learning process that remained after the dust of the earlier theoretical turmoil had settled was trial-and-error learning.

Trial-and-error learning resembles the Darwinian two step process of blind-variation-and-selective-retention. In trial-and-error learning the trials, like mutations,

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[901] See e.g., J. Bredenkamp, W. Wippich, *Lern- und Gedächtnispsychologie* (1977), pp. 55-60

[902] This has also been stressed by the recent tide of process-Darwinism: H. Plotkin, *Darwin Machines and the Nature of Knowledge* (1994/1995), pp. 73 f. D. Campbell, *Epistemological Roles for Selection Theory* (1990).

[903] E.g., B. F. Skinner, *The Behavior of Organisms* (1938), pp. 4, 44; *Contingencies of Reinforcement* (1969), pp. 75-78.

[904] "I do not mean that there are no originating forces in spontaneous behavior but simply that they are not located in the environment. We are not in a position to see them, and we have no need to." B. F. Skinner, *The Behavior of Organisms* (1938), p. 20.

could be broken down into small units, which retain their identity.[905] A pigeon in a 'Skinner box' which needs to push a button to get food shows a variety of different trials in a random way. This corresponds to the first step of the Darwinian process, the process of blind-variation.

It is assumed that any behaviour (here the pushing of a button) correlated e. g. with food will be reinforced – only, of course, if the pigeon is hungry or, empirically speaking, if it had been deprived of food. Generally it is argued that behaviour which has an approximately simultaneous positive outcome is reinforced, i. e. it becomes more probable to occur again. The trials which failed to have such effects tended to become extinct, like less favoured genes or species. This aspect of trial-and-error learning corresponds to the selective-retention step of natural selection where different trials are selected according to their adaptation to a given environment. The theory of operant conditioning – like Darwinism – stringently advocates that the 'evolution of individual behaviour' takes place in a gradual way and in this respect differs, for example, from *Gestalt*-psychology.

In the same way that biological Darwinism has emphasised that the Procrustean law of natural selection is in a Newtonian way universal and immutable throughout nature, proponents of psychology based on operant conditioning – with only little reservation[906] – have also tended to advocate an exhaustive applicability of trial-and-error-learning equally for flatworms, rats and humans.

Thorndike's approach finally fundamentally resembles Darwin's treatment of phylogenetic purpose, moving the explanation of an adaptation from the future to the past and abandoning the original meaning of concepts "like purpose, intention, expectancy, or utility"[907].

> Nevertheless it may of course be objected that the outlined analogy is not valid in every respect. For example the 'extinction' of a behaviour is not as irreversible as the final extinction of a species.

(2) Both psychological trial-and-error learning and biological natural selection have been criticised for being tautological in a similar respect.

One of the main claims of the Darwinian research tradition is that natural selection leads to '*the survival* of the *fittest*'. It has often been pointed out that this claim (not natural selection as a whole) has regularly been understood in a tautological way, because *fitness* is naturally defined by *survival:* The ultimate test for the fitness of an entity (gene or organisms etc.) is whether it survives. But such a definition leads to the proposition that the *survivor will survive,* an indeed undeniably true but empty tautology.

To avoid this problem alternative definitions of fitness have also been proposed. Fitness for example could be defined by the probability of *long term* survival. In this case the claim 'survival of the fittest' will no longer be tautological – but also no longer always true. Short term adaptations do not imply long term adaptations. The

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[905] B. F. Skinner, *The Behavior of Organisms* (1938), p. 33; *Contingencies of Reinforcement* (1969), p. 106.

[906] B. F. Skinner, *The Behavior of Organisms* (1938), p. 442.

[907] *Idem*, *Contingencies of Reinforcement* (1969), p. 106.

dinosaurs became extinct, and humans try to achieve the same result today. The charge of tautology needs to be taken seriously.

> This does not imply that the claim that a Darwinian two step algorithm leads to evolutionary change is tautological. Nevertheless, I think that strict (but non-tautological) pan-adaptionism – despite claims of many Darwinians – could not be warranted. (On the tautological aspects of Darwinism, ➲ pp. 339 f.)

In operant conditioning an analogy to the tautology of 'survival of the fittest' could be found in Thorndike's law of effect or Skinner's principle of reinforcement: "If the occurrence of an operant its followed by presentation of a reinforcing stimulus, the strength is increased."[908] The likelihood or strength of a behaviour is increased if it becomes reinforced. But the explanans is in turn defined by the explanandum. Reinforcement is normally defined by an increased likelihood or strength of a shown behaviour. The resulting proposition 'the likelihood of a behaviour is increased, if the likelihood of a behaviour is increased' is once more logically true, but not helpful. If the likelihood to be (here of a behaviour) is equated with survival than this claim becomes structurally similar to the above claim of 'the survival of the survivor'.

> Nevertheless, besides their mere different level of application, other differences between both claims remain. The proposition 'the likelihood of a behaviour is increased, if the likelihood of a behaviour is increased' is not the direct but rather the dynamic and probabilistic equivalent of 'the survival of the survivor'. But to use the terms 'increase' and 'likelihood' may not make an essential difference and also 'survival of the fittest' might be understood in a dynamic and probabilistic way.
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> It appears to be more relevant that fittest seems to refer to the past, present or future, whereas reinforcement seems to refer the past and present only. Furthermore the superlative 'fittest' has an emphatic connotation of the *very* best, which is less so in the case of the law of effect. Finally, the law of effect often treats the probability of *one* behaviour, whereas 'survival of the fittest' treats the differential survival of *different* entities.
>
> If the mentioned differences turned out to be essential, then the discussed propositions could not both completely be tautological. Despite this problem, I hope to have shown that both claims have, at least partly, to be interpreted as a tautology of the 'survival of the survivor'. Further comparative investigations are needed.

In the field of operant conditioning attempts have also been made to avoid the charge of tautology and to re-define reinforcement.[909] I am not going to discuss these alternative definitions, but I would tend to suggest that some of them may mirror the chances and problems of the refined definitions introduced to avoid the mentioned biological tautology.

(3) I finally want to suggest that Darwinism may follow the fate of trial-and-error theory to be complemented or replaced by a different paradigm which allows also less blind and more complex forms of learning or evolving.

We have seen that the theory of operant conditioning while denying biologism paradoxically introduced the blind and gradual Darwinian mechanism into psychology.

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[908] *Idem*, *The Behavior of Organisms* (1938), p. 21.

[909] H. Westmeyer, *Kritik der psychologischen Unvernunft* (1973), quoted in J. Bredenkamp, W. Wippich, *Lern- und Gedächtnispsychologie* (1977), pp. 115-124.

The theory of operant conditioning stayed dominant in psychology till the early 1970s and often was advocated as a universal (ubiquitous and unchanging) explanation of learning. Also in this respect it resembled the orthodox Darwinian claims to provide a universal explanation of biological 'learning'.

But already while still being orthodox the theory of conditioning – like Darwinism – kept being challenged by remaining heterodox schools, like, for example, Piaget's stucturalist developmental psychology.[910] Also, for example, remaining *Gestalt*-psychologists favoured a sudden process of understanding, an *Aha-Erlebnis,* and hence advocated what we may call a saltational theory of learning.

> Likewise in the history of science there are continuous disputes how far discoveries are gradual and saltational. What happened as the famous anecdotal apple fell on Newton's head or as Darwin read Malthus?[911]

In psychology much of the external criticism was first advocated in a less radical form from within a transformed version of the original orthodoxy. Nevertheless (and despite the radicalisation of the orthodoxy by Campbell) as mainstream the paradigm of behaviourism and trial-and-error learning finally became replaced by the paradigm of cognitive psychology.

Already Bandura, still rooted in behaviourism, criticised the sole behavioural 'adaptation' to an external environment and stressed a 'reciprocal determinism' of environment, person and behaviour.[912] Moreover one increasingly acknowledged further complex psychological entities and processes, like cognitive maps, the information content of situations, concept learning, metacognitions and the (rather teleological) concept of expectations. These concepts partly complemented, partly contradicted the strict assumptions of trial-and-error psychology. Important early contributions to an initiation of a psychological paradigm shift have e. g. been made by R. Rescorla and E. Tolman.

In a similar way as after many years of dominance orthodox trail-and-error-psychology became questioned and replaced by an approach which also took 'higher' mechanisms into account, I think the biological trial-and-error theory of Darwinism might also be urged to drop its universalism and acknowledge a certain evolution of evolutionary mechanisms.

In psychology there is also of course still good evidence of the simple learning processes of trial-and-error learning, from flatworms to humans. Nevertheless, simple

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[910] E.g., J. Piaget, *The Construction of Reality in the Child* (1953).

[911] Darwin himself wrote of a sudden insight while reading Malthus on the 28th September 1838. Correspondingly it was often advocated that Darwin was an intellectual revolutionary. E.g., E. Mayr, *Darwin, Intellectual Revolutionary* (1983). Nevertheless even Mayr sometimes argues that "Darwin had been gradually conditioned", *One Long Argument* (1991), p. 78, ➲ footnotes 742-744. In my view it seems wrong both to assume that Darwin had no predecessors but only a sudden ingenious idea and to describe the rational combination and transformation of theories as a mere act of 'gradual conditioning'.

[912] A. Bandura, *The Self System in Reciprocial Determination* (1978), quoted in H. M. Trautner, *Lehrbuch der Entwicklungspsychologie* (1991), pp. 140-145.

trial-and-error processes do not seem to suffice for an exhaustive explanation of all learning processes. Learning does not proceed unchanged from flatworms to humans.

Instead of emphasising a mere paradigm shift from behaviourism to cognitive psychology, it would be preferable to stress that the current paradigm partly encloses older approaches and advocates the unfolding of mechanisms which indeed finally necessitate an almost opposed approach to learning.

In 1949 Harlow already had shown that rhesus monkeys could 'learn the learning' and acquire new learning mechanisms transferable to other situations. The learning of a discrimination task at first proceeded gradually, but the monkeys in later experimental series showed that they had aquired the ability to solve a problem suddenly 'by insight'. Stressing insightful behaviour – now clearly interpreted as learned – has to be interpreted as rehabilitation of the Gestalt-psychologist Köhler.[913] However, here the apparent change of the learning process itself is remarkable.

Kendler and Kendler have subsequently shown that young children more easily learn to identify a second concept if only a few properties of that concept are changed and not a full reversal shift of all properties is required; the converse is true for older children.[914] Whereas the learning of younger children appears to be consistent with ordinary conditioning theory, the learning of older children appears to require an additional theory of mediation, which is maybe based on, but is not, I think, reducible to this original theory. It has also been shown that not all animals that could be conditioned are capable of such reversal learning; for example M. E. Bittermann has shown recently that some species of fish are not capable of reversal learning.

If such a perspective of an unfolding manifold of learning mechanisms were extended to all acknowledged mechanisms of cognitive psychology (in a way in part opposed to the original behaviourist concepts), the theory of universal trial-and-error learning would not be replaced but transcended by a theory of the learning of learning. Trial-and-error-mechanisms may be existing simple learning mechanisms, but this would not be the end, but the beginning of a theory of learning. In the further course of this work I am going to argue that biological Darwinism might be similarly transcended by a more truly evolutionary metaphor of the evolution of evolutionary mechanisms (➲ pp. 363 f.).

c) Popper's Falsificationism – Science as Darwinian Process?

Sir Karl Raimund Popper's (1902-1994) falsification theory of knowledge in some respects resembles a Darwinian process. The process of conjecture and refutation turns out to be a process of blind-variation-and-selective-retention.

> Apart from Popper's approach *other recent metascientific works* are also based on a metaphor of biological evolution. According to Toulmin scientific disciplines evolve like biological species. But I think closer scrutiny shows that the biological analogy to Toulmin's approach would rather be Lamarckism than Darwinism. Richards who, in the wake of Campbell, proposes a selectionist view for the historiography of science, only uses Darwinism as a

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[913] H. F. Harlow, *The Formation of Leaning Sets* (1949). See e.g., J. Bredenkamp, W. Wippich, *Lern- und Gedächtnispsychologie* (1977), pp. 154-157.

[914] T. S. Kendler, H. H. Kendler, *An Ontogeny of Optional Shift Behavior* (1970).

> loose analogy. In my understanding his metaphor would have to be located somewhere between what I call Lamarckism and Darwinism.[915]

Basing his position on the Humean problem of induction, Popper in *Logik der Forschung* (1934) criticised the prevailing view that science is fundamentally inductive.[916] Alternatively he advocated his theory of falsification, based on the *logical* argument that strictly one contradiction could prove a theory to be wrong, whereas no theory could ever be totally verified and not even verified at all. According to Popper in principle there is neither a guaranty nor even a higher probability that new phenomena will support old generalisations.

> Popper nevertheless offered a theory of corroboration. This theory has been interpreted as re-introducing a crypto-theory of induction through the back door.[917]

At the latest in *Objective Knowledge* (1972) I think Popper also admitted that the strict argument derived from formal logic is not applicable; otherwise practically no theories which could be regarded as acceptable would be left at all. Even in the case of the prototype of a mature science, physics, its central theory of relativity or of quantum physics both show some anomalies.[918] But Popper is not only inspired by this logical argument; he is also directly influenced by Darwin, whose books he had read before he started to write philosophical texts.[919] Popper himself advocated that the development of knowledge 'from the amoeba to Einstein' could largely be seen as a Darwinian process.

> The "growth of our knowledge is the result of a process closely resembling what Darwin called 'natural selection'; that is, the natural selection of hypotheses: our knowledge consists, at every moment, of those surviving so far in their struggle for existence; a competitive struggle which eliminates those hypotheses which are unfit. [...] The theory of knowledge which I wish to propose is a largely Darwinian theory of the growth of knowledge. From the amoeba to Einstein, the growth of knowledge is always the same: we try to solve our problems, and to obtain, by a process of elimination, something approaching adequacy in our tentative solutions." [920]
> "In order to make the method of selection by elimination work, and to ensure that only the fittest theories survive, their struggle for life must be made severe for them."[921]

Popper's concept of conjecture and refutation is a Darwinian two step process of blind-variation-and-external-elimination (➲ pp. 358 f.). In regard of the first step, it has often been advocated that Popper interprets "scientific discovery as fundamentally an accidental occurrence, a chance mutation of ideas"[922]. Those aspects which do not

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[915] R. J. Richards, *Darwin and the Emergence of Evolutionary Theories of Mind and Behavior* (1987), pp. 578, 581, 592.

[916] K. R. Popper, *My Solution of Hume's Problem of Induction* (1974). (also ➲ pp. 210 f.).

[917] H. Putnam, *The 'Corroboration' of Theories* (1974), esp. pp. 222-223. I. Lakatos, *Popper on Demarkation and Induction* (1974), pp. 256, 261. ➲ footnotes 852, 853.

[918] For critical aspects of applying Popper's logical argumentation to complex phenomena, see also: W. v. O. Quine, *On Popper's Negative Methodology* (1974), ➲ footnotes 851.

[919] K. R. Popper, *Objective Knowledge: An Evolutionary Approach* (1972), p. 67.

[920] *Ibid,* p. 261.

[921] K. R. Popper, *The Poverty of Historicism* (1957), p. 134.

[922] R. J. Richards, *Darwin and the Emergence of Evolutionary Theories of Mind and Behavior* (1987), p. 576.

appear to be chance trials are due to a (blind) re-application of older knowledge.[923] In regard of the second step these blind trials are tested against nature or the real external world.

Although these parallels are far reaching, I also want to mention that Popper partly stepped back: a) The tree of *biological* evolution branches more and more, growing up *from* one common stem, whereas the tree of human *knowledge* springs from countless roots, which tend to *unite into* one common stem. b) Human knowledge is regulated by the idea of truth rather than by the idea of helping us to survive.[924] c) In the second step of the Darwinian process, the agent who eliminates is not nature, but the scientist or the scientific community. It is questionable whether one should equate the scientific community with '(natural) selection', because one may argue that than *any* cause for the selection of an entity, i. e. for its being or not being, could inappropriately be called 'natural selection' (➲ pp. 358 f., 394 f.).

Hence Popper seems to be more cautious than some modern Darwinian epistemologists, nevertheless it is not disputable that the concept of a process of conjecture and refutation has mainly been inspired by the concept of a Darwinian process.

It is paradoxical that Popper, in particular, imported a concept of a Darwinian process into the theory of science: By deriving the pivotal criterion of falsifiability in its refined form not from logic but from Darwinism, he cannot help applying this criterion to Darwinism itself. But the Darwinian concept of 'survival of the fittest' often understood as 'the survival of the survivor' is at least partly tautological (➲ pp. 229, 339 f., 350 f.) and thus Darwinism did not fulfil his (Darwinian) criterion of falsifiability. It was indeed Popper who pointed out that a "considerable part of Darwinism is not of the nature of an empirical theory, but is a *logical truism*."[925] But as Popper wanted to build up a *normative* metascientific approach – to him theories *ought to be* constructed in a falsifiable way. Popperians need to criticise unfalsifiable aspects of Darwinism. Nevertheless I think that Popper himself based the normative aspect of his methodology on exactly the tautological belief that a 'Darwinian process' leads to the 'survival of the fittest'. Only on this basis could he assume that the Darwinian process of conjecture and refutation ultimately leads to the growth of knowledge and an approximation to the truth. If alternatively fitness is *not* defined tautologically in terms of momentary survival, it is not guaranteed that natural selection implies survival of the fittest. If Popper had applied this insight not only to Darwinism but to his own theory of theory development, the assumed best approximation of the truth by a Darwinian process would, I think, have become doubtful. Thereby the descriptive basis for Popper's normative claim would largely have been lost.

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[923] K. R. Popper, *Campbell on the Evolutionary Theory of Knowledge* (1974).

[924] *Idem*, *Objective Knowledge: An Evolutionary Approach* (1972), pp. 262-4.

[925] *Ibid,* p. 69.

> Lakatos may also have pointed to a similar problem when he moaned that Popper never answered the question "Under what conditions would you give up your demarcation criterion?"[926]

Popper not only charged Darwinism with being partly tautological, but he also tried to reform it along the lines of the Baldwin effect. The alterations in the executive organs must follow alterations in central organs. In a way he reintroduces a moderate form of orthogenesis and Lamarckism within a largely Darwinian framework.[927] But if this insight were transferred back to his process-Darwinian theory of science, an unmodified falsificationist theory would be incomplete.

In summary, I think that the Darwinian core of Popper's own theory becomes inconsistent if his theory becomes applied to itself.

7.2 Other Components of Process-Darwinism

The Darwinian processual monism was not only transferred to the fields of psychological learning and the theory of science, but was also applied in different ways *within* biology and also in other fields such as, for example, economics.

a) Antibodies and Neurones

The prototypic inner-biological field of applying a Darwinian process is evolutionary biology. The Darwinian process has often been applied only on one level. For example, gene-Darwinians claim that the gene is ultimately the only level of selection. But we have already outlined the more moderate multi-level-approach, applying Darwinian processes on many levels, for example, on the level of groups. Whereas processes of Darwinian theories of evolution are normally concerned with the germ-line, in biology Darwinian processes of *somatic* selection have also been proposed, e. g. for the neural development and the immune system.

From the viewpoint of universal Process Darwinism these processes will be regarded as the same algorithm or heuristic as Darwinian evolution itself, nested upon the primary Darwinian process. Such nested algorithms evolved by chance and simply have never been eliminated.

> But actually somatic theories of selection have often been opposed to pure theories of germ-line selection.[928] Somatic theories at least ontogentically are concerned with *aquired* characters.[929] Theories of somatic selection are Darwinian on a certain level, but might have quite non-Darwinian results on another. I will not discuss here whether these theories should hence indeed be regarded to be Darwinian. Only later I will generally discuss inconsistencies of an approach of nested Darwinian processes (➲ pp. 336 f.).

In addition to his theory of selection of individual organisms Weismann after 1895 postulated a theory of somatic selection of cells, tissues and organs, as postulated

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[926] I. Lakatos, *Popper on Demarkation and Induction* (1974), pp. 245-246.

[927] K. R. Popper, *Objective Knowledge: An Evolutionary Approach* (1972), p. 278.

[928] E. J. Steele, R. A. Lindley, R. V. Blanden, *Lamarck's Signature* (1998), p. 101.

[929] Sir P. B. Medawar and Sir F. M. Burnet were awarded the Nobel price in 1960 for the discovery of '*aquired* immunological tolerance'.

already by Roux, and proposed a theory of '*Germinalselektion*', claiming a struggle among 'determinants' for nutrition available within the germ plasm.[930]

Here I can only briefly touch upon a Darwinian approach to the functioning of the immune system. The immune system for a long time was thought to work according to purely Lamarckian instructional mechanisms. It was thought that the immune response of the antibodies is not very wasteful but a flexible variable reaction informed by antigens. In contrast, the presently widely held theory of 'clonal selection' is normally understood along Darwinian lines. The theory was proposed by N. K. Jerne and elaborated by F. M. Burnet, who coined the term 'clonal selection'[931]. According to this theory the immune system in a first step blindly produces a vast abundance of cells which produce specific antibodies (immunoglobulins). These cells preexist before their first antigenic encounter. If an antibody is 'selected' by an antigen, its mother cell becomes multiplied in a process of cloning.[932] Even T. Steel, a present proponent of scientific neo-Lamarckism – on the level of the organism –, actually advocates a somatic selection theory on the level of the antibodies.[933]

However, following process-Darwinism this secondary algorithm of an immune 'reaction' is identical with and iterating the primary algorithm of evolution, i. e. natural selection.

b) Darwinian Economics?

The structural similarity of some aspects of neo-classical economics and neo-Darwinian biology has in recent decades been newly acknowledged.[934]

I have outlined some historical similarities of (neo-)classical economics and (neo-)Darwinian biology before. Such resemblances appeared to be due partly to a *direct* historical interaction of Darwinian biology with Smithian, Malthusian and Friedmanian economics, and partly to an *independent* yet similar development of both subjects, growing in a similar intellectual environment on the same fertile Newtonian soil. Here I shall give only a simplified, idealised account of these comparisons (➲ pp. 173 ff., 198 f.).

Economists following in Smith's wake of classical economics till today mostly applied what I called the 'principle of egoism' on the level of individuals and favoured unrestrained competition. Individuals strive and even ought to strive only to maximise their own benefit. Darwin adopted the principle of egoism in his middle period and likewise applied it on the level of single organisms.

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[930] E. Mayr, *Weismann and Evolution* (1985), p. 321.

[931] See: F. M. Burnet, *The Clonal Selection Theory of Acquired Immunity* (1959). E. J. Steele, R. A. Lindley and R. V. Blanden give a historical sketch in *Lamarck's Signature* (1998), pp. 95-102, esp. p. 95.

[932] It might be questioned whether this 'selection' should properly be called 'natural' or external, because the organism itself actively contributes much more than in normal natural selection to create this process (➲ pp. 394 f.).

[933] ➲ p. 148.

[934] See some critical comparisons, e.g., of E. L. Khalil, *Neo-Classical Economics and Neo-Darwinism* (1992). G. M. Hodgson, *Economics and Evolution* (1993).

Darwin first conceived his concept of natural selection as he read Malthus' *Essay on the Principle of Population*. Malthus' influence on Darwin has been much discussed. The Darwinian concepts of unconstrained growth of population, of scarcity of recourses, and of struggle for life definitely owed much to Malthus, who also counts as one of the founders of neo-classical economics. Although Malthus also firmly advocated that dependent "poverty ought to be held disgraceful"[935], he like Smith still optimistically held that egoism, competition and struggle would finally lead to the good of all and not only to the survival of the fittest.[936] Notwithstanding such differences, I have shown earlier that some parallels of classical economics with Darwinian economics remain to be striking.

> With few exceptions the application of the principle of egoism on the level of the individual (or of the household) dominated mainstream economics since Smith. This was consolidated by the rise of neo-classical economics after 1870. But other explanatory levels had also been proposed. In economics there is an old 'unit of explanation' or even 'unit of selection' debate. Even a substantial autonomy of macroeconomics has been proposed, e. g. by Keynes. Additionally a macroeconomic approach resulted naturally from new methods like national income accounting.[937]

In the 1970s the microfoundationalist approach was advocated with new vigour and for a while forced back the concept of a certain autonomy of macroeconomy. Friedman, without taking a biologistic stance, has explicitly adopted the central concepts of natural selection, competition and survival of the fittest from Darwinian biology as building blocks of his microfoundationalist approach. Specifically he shared with gene-Darwinians a Panglossian brimming with natural selection, which led him to his normative demand of severe competition (➲ p. 198). Similarly von Hayek – though not strictly a neo-classical economist – strongly emphasised the universal necessity of competition and likewise emphasises a trial-and-error process of cultural selection. Moreover he demanded the abandoning of the 'atavistic concept' of social justice.[899] Becker and Hirshleifer – inspired by gene-Darwinism – have advocated an account of the biological evolution of the 'rational economic man', providing the bridgehead for the 'principle of egoism' and the goal of maximisation of profit, as is predicted by neo-classical economics.[938]

But let us step back for a moment. Not every 'evolutionary economics' is necessarily Darwinian, since they for instance advance group selectionism or a richer ontological process inventory, going beyond blind-trials-and-external-selection.[939] If

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[935] R. Malthus, *Essay on the Principle of Population* (1798), p. 85. (➲ pp. 174 f.).

[936] P. J. Bowler, *Malthus, Darwin and the Concept of Struggle* (1976). For more ➲ footnote 730, 732.

[937] G. M. Hodgson, *Economics and Evolution* (1993), pp. 236 f, 259 f.

[938] G. S. Becker, *Altruism, Egoism, and Genetic Fitness: Economics and Sociobiology* (1976). J. Hirshleifer, *Economics from a Biological Viewpoint* (1977); *Natural Economy versus Political Economy* (1978); *Evolutionary Models in Economics and Law: Cooperation and Conflict Strategies* (1982). See: G. M. Hodgson, *Economics and Evolution* (1993), pp. 28-31.

[939] G. M. Hodgson provides a classification of a variety of different approaches to evolutionary economics in *Economics and Evolution* (1993), pp. 39 ff. Cf. the antology G. M. Hodgson (Ed.), *Darwinism and Economics* (2009).

these theories are only broadly generally inspired by evolutionary theory they should better be called 'evolutionary economics'.

There are two Darwinian approaches to economics. *Biologistic* Darwinian Economics advocates the importance of the biological nature of human beings and understands this nature in a Darwinian way. This approach is an expression of universal biological Darwinism in the field of economics. In difference, Darwinian Process Economics focuses on Darwinian processes of natural selection potentially not only on the level of genes but at the level of particular economical entities – without advocating group selectionism. Hence this approach is linked to Process Darwinism. The predictions of these two types of Darwinian economics may often be mutually exclusive. Some proponents of Biologistic Darwinian Economics have advocated a psychology according to which rationality is understood as being adapted to the conditions of the Pleistocene or even of the Stone ages, whereas a Process Darwinian Economics tends to assume that the economic sphere is moulded by blind economic trials and errors (➲ pp. 336 f.). Global rationality – or adaptation – is here assumed to arise from mere trial and error processes. This assertion is, of course, by no mean unproblematic.[940]

If theories of economic Darwinism are scrutinised many interesting problems arise. Are we indeed concerned with an irrational trial-and-error-mechanism? Is there an equivalent to *blind* overproduction of economic products, agents and firms? What entity has to be regarded as selector? Is the selector 'natural'? Should we call selection by humans exogenous, like Darwinism claims that natural selection is exogenous? Which entities are the units of economic evolution, genes, individuals, social groups, companies, regions, countries, multi-national giants, or trade blocs? Is economy in some regards autonomous from the biotic world?

> It is even questionable whether 'real existing capitalism' could be interpreted in a Darwinian way. E. g. the tendency to build global companies may contrarily be interpreted as a tendency to build large co-operative and planned entities.

It is not within the scope of this work to discuss these problems of Darwinian economics separately, but in Part IV a *general* discussion of universal Darwinism will be given.[941]

> Darwinism – in a historical variety of meanings – combined with several different ideologies has actually influenced economics and politics in many more ways than could have been mentioned here.[942] In the present section we were only concerned with the interaction of Darwinism with neo-classical economics.
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> In this context it also should be mentioned that in politics Thatcherism and Reaganomics was inspired by Friedman, who explicitly had imported some central concepts from Darwinism (➲ pp. 198 f., also pp. 180 f.).

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[940] B. Sloth, H. J. Whitta-Jacobsen, *Economic Darwinism* (2006).

[941] For a biologically informed critique of economic Darwinism: G. M. Hodgson, *Economics and Evolution* (1993), pp. 234-250. E. L. Khalil, *Neo-Classical Economics and Neo-Darwinism* (1993), pp. 36-57.

[942] P. J. Bowler (1984/1988), J. C. Greene (1977/1981), M. Hawkins (1997), R. Hofstadter (1955); ➲ footnotes 458-461.

Also later after the collapse of the 'real existing socialism' in Eastern Europe the only remaining utopia seemed to have been the harshening of the economic struggle for existence on all levels. According to the United Nations Conference on Trade and Development, countries, primarily in the Third World and East Europe, during the early 1990s 'liberalised' some hundred economic laws. I do not intend here to argue that this was plainly wrong. But since then even known advocates of a market economy have pointed out that this predominant tendency may go to far and that a totally unconstrained capitalism and a resulting pauperisation of large parts of the society may become the true enemies of an 'open society'[943].

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[943] G. Soros, a Hungarian multi-millionaire, formerly influenced by Popper, now criticises boundless capitalism, *The New Paradigm for Financial Markets: The Credit Crisis of 2008 and What It Means* (2008). See also: The Group of Lisbon, *The Limits of Competition* (1995).

Conclusion – The Universal War of Entities

This wonderfully simple metaphysics of Universal Darwinism advocates an ontology of total war. Hobbes' state of nature is radicalized and is turned into a highly general and apparently logic-based metaphysics. Entities are by definition egoistic and strive to outstrive each other. Panglossism is explained by Panbellicism. The reason for any apparent harmony is an eternal and omnipresent struggle, a truly *bellum omnium contra omnes*.

Two types of Universal Darwinism have been proposed: Universal biological Darwinism (biologistic Darwinism) reduces all entities and processes of culture to Darwinian biology. In its gene-Darwinian version even within biology only genes exist. Genes have replaced God as the puppeteer, pulling the strings from within our bodies.

Universal Process Darwinism – on which we have focused in the present part – has a slightly richer ontological inventory. There are not only genes, but possibly also genomes, gene-pools, organisms, groups and species; and even cultures, theories and economic firms may be accepted as causal agents. Nevertheless there is only *one* mechanism: blind-variation-and-external-retention (➲ p. 359). The relentless struggle continues on all existing levels. The existence of entities even appears to be defined by their egoistic struggle for life. Other entities are mere means and sometimes not regarded to be essentially real. Antibodies, organisms, the economic man, but also friends, ideas and theories are all fighting only for their own survival.

Whether biologistic or process Darwinism, it seems that Darwinism has replaced theism as a universal explanation: everything exists not because of God's creation, but because of the eternal unchangeable mechanism of natural selection.

It seems hopeless to try to transcend the state of nature culturally, because either culture essentially does not exist, or culture is condemned to work according to the same brute and blind mechanism. Nietzsche and Schopenhauer, dressed in a more respectable Newtonian mantle, seem to celebrate their ultimate victory. Will and life are blind and the world is necessarily and exhaustively bad (or 'value-free'). From a more traditional viewpoint it appears that existence is indeed a mistake and we are living not in the best, but in the worst of all possible worlds.

The blind and irrational aspect of life are now declared to be universal; neither in nature nor in culture a preordained, rationally and ethically ordered *logos* remains. The romantic urge for unification (➲ p. 193) which challenged Descartes' dualism is now not formulated in the way of traditional idealism or traditional life philosophy, but in a materialistic, mechanistic and largely atomistic way. The long-accepted Cartesian cultural compromise had been based on the contrast of *machina mundi* and *alter deus*: of an atomistic and causal world of physics and biology, and a teleological world of culture, ethics and purpose. As historically sketched the modern *alter deus,* the free human subject, finally has become incorporated into the mechanistic vision of *machina mundi.* The enormous project of the Christian disenchantment of Nature (➲ p. 73) has not only achieved the eradication of polytheism, but finally turned against Christianity itself and even against the remaining secularised humanism. Gene-Darwinism and even process-Darwinism may be seen as the final nails in the coffin of the free *alter deus*. According to modern gene-Darwinism, humans are nothing but gene-machines. Even according to the already much more moderate process-Darwinism nature and culture are blind by definition.

Even today Universal Darwinism is, in my opinion, paradoxically sustained by the theistic concept of universal laws, eternal ideas of God. Whereas the Darwinian blind understanding of evolution undermined any essence and purpose, gene-Darwinism and process-Darwinism are surprisingly themselves based on the almost last remaining island of Platonic statics, on a probabilistic but itself eternally unchangeable mechanism, natural selection. As it was in the beginning, it is now, and ever shall be: a world of unrestrained and ruthless competition.

In this part we were concerned to develop versions of Universal Darwinism, not at least to make it accessible, disputable and worth attacking. A mere stigmatisation of these approaches would ignore their positive aspects, which may even partly serve as seeds to transcend this paradigm itself. It would indeed be a tribal conception of science to think simply of two opposed theoretical camps fighting against each other. There is a dynamics of theories, where we indeed have to decide what theory we prefer, but thesis and antithesis are not only opposed, but often mutually dependent. Moreover the intentions of developing a theory may sometimes differ from its final implications.

> Paradoxically, even gene-Darwinism, the most purified form of Darwinian materialism, mechanicism and reductionism, could, in my view, be seen as a turning point towards a metaphysic based rather on information than on matter. The information of genes, not their incorporation by particular molecules is crucial to gene-Darwinism (➲ pp 255 f.).

Although in this part we aimed at developing Darwinian metaphysics we have already found some cracks within this position; but these inconsistencies are more systematically treated in Part IV. As the different approaches inspired by Darwinism have fortified each other, we will see that the criticisms uttered in different subject areas may support each other as well.

Part IV: Transcendence of Gene-Darwinism and Universal Process-Darwinism

"A civilisation which cannot burst through its current abstractions is doomed to sterility after a very limited period of time."

Alfred North Whitehead, 1925.

A Critique of Universal Darwinism, covering particularly gene-Darwinism but also process-Darwinism,[944] needs to be written. This became clear as much from the unbearable ethical tendencies, which these world-views appear to have, as from their inconsistencies,[945] such will be addressed systematically in the course of this fourth part. A first account will be given of how these metaphysical frameworks should be transcended. It appears to me that the current scientific and philosophical discourse concerning Universal Darwinism, though in some respects quickly progressing, in others is trapped by a set of mutually supporting assumptions, which need to be challenged in parallel, if a preferable theoretical position should be reached. I use the term 'transcend' (from Latin *transcendere,* to go beyond) to indicate that my criticism methodically does not start the discussion from an *alternative* viewpoint, but from *within* the metaphysics of Universal Darwinism. By criticising these dangerous, but also unifying and innovating ideas from within, we still try to go beyond this position.

I am also using the old-fashioned word 'transcend' to indicate the belief that by attacking the metaphysical system of Universal Darwinism we may also learn something from traditional metaphysical systems. I am advocating this without approving a generally backward-looking approach. New problems often do need to be solved in new ways, but after much of the metaphysical lumber had been cleared out by analytical philosophy (at least in the English-speaking world), two points, I think, should be realised. Firstly, the remaining scientific world-view – as it also becomes

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[944] These terms have been introduced earlier, ➲ pp. 205 f.

[945] ➲ esp. pp. 41 f., 221 f.

clear in this work – itself is based on some highly general, empirically not directly testable, and in this sense metaphysical assumptions (➲ e.g. pp. 4 f.). Secondly, also concepts have been abandoned, which are required to resist Universal Darwinism. While we should try to retain the achieved clarity of analytical philosophy, I think, we should come back to realise that we are only 'dwarves on the shoulders of giants'. However, I concede that these dwarves – we – now have to try to see further than the giants have ever seen before.

This present criticism of mine will focus on two main classes of *reductionism*, which have been shown to be at the very heart of the two strands of Universal Darwinism (➲ pp. 205 f.), specific types of *substance reductionism* and *process reductionism.*

Gene-Darwinism, today's most radical form of Universal Biologistic Darwinism, has been characterised by an extreme biological *substance reductionism,* advocating what I have called 'gene-atomism' and 'germ-line reductionism'. The selfish gene view of evolution is also tied to the principle of entity (gene) egoism. Moreover, also gene-Darwinism is characterised by a radical form of *process reductionism*, i. e. Darwinian process-monism, according to which the process of mutation and elimination is the only real evolutionary mechanism. Modern nominalism indeed has reached another heyday (➲ pp. 138 f., 191 f., 215 f.).

The other class of theories which could be subsumed under Universal Darwinism is Universal Process Darwinism. Universal Process Darwinism, contrary to Universal Biologistic Darwinism, allows the emergence of new entities like biological species, theories or economic companies, but still denies the emergence of new evolutionary processes. Universal Process Darwinism is hence characterised only by *process* reductionism, advocating that there is only one essential process in both biotic and cultural evolution, the Darwinian process of natural selection (➲ pp. 216 f.).

In the following discussion substance reductionism and process reductionism will be criticised in two separate sections. Alternative accounts, which only can be outlined, are presented where they would replace the related types of reductionism.

Chapter 8:
Transcendence of Substance-Reductionism

In this chapter, I argue that the substance reductionism, which is employed in gene-Darwinism, leads to fundamental theoretical problems.

Generally speaking, the discussion of reductionism, particularly of substance reductionism, seems to be a modernised version of the mediaeval *Dispute about Universalia.* Do general entities or terms (universals like 'species', 'genera' etc.) exist before and out of particular things (*ante rem*), do they exist inseparably within particulars (*in re*), or are they mere convenient abstractions (*in intellectu / post rem*)?[946]

In today's philosophy of biology this dispute is concerned with the question of the unit of selection, or more generally the unit of explanation. Different largely Darwinian subparadigms, as we have seen, employed quite different types of substance reductionism (➲ pp. 102 f.). Darwin himself during his middle period, at the time when he wrote the *Origin*, believed only in the existence of single organisms; only later did he put a little more emphasis on groups and even returned to a typological definition of species. In Fisherism, the first step towards the evolutionary synthesis, the evolutionary relevance of single genes and whole gene pools was advocated. Proponents of the second step of the synthesis added the essential importance of the phenotypic population structure. Gene-atomism and germ-line reductionism of gene-Darwinism, often found in sociobiology, supposes that single selfish genes are the sole agents of evolution, the rest are gene machines, vehicles, or mere means to the genes' end. The impressively meagre gene-Darwinian ontology, with which we are concerned here, claims to cover all apparently existing things, including complex forests outside of us, up to the moral beliefs inside us.

To approach the critique of substance reductionism of this genetic kind, we must first discuss problems of (entity) reductionism in general and then get closer to the specific problems of genetic substance reductionism.

8.1 Problems of Physicalism and Reductionism in General

a) The Difference between Explanation and (Downward) Reduction

If 'reduction' is defined in a very general way, *some sort of* reductionism seems to be unavoidable. The core of the notion of reduction (Lat.: *reducere*) is to trace something back to something different. This seems to be linked to the indispensable notion of 'explanation'. An explanation has something to do with restating a phenomenon in different words, which are themselves understood better.

But the term 'reduction' in philosophy of science today is normally not used so generally. In the wake of logical positivism primarily downward, rather than upward or horizontal, reduction is implied. With this geometric metaphor I presuppose a

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[946] A broad collection of classical and modern texts concerning the dispute about universals is: H.-U. Wöhler, *Texte zum Universalienstreit* (1994), Volume 2.

hierarchy of complexity: from particle physics, atomic physics, chemistry, biology up to sociology. Within the vertical dimension it is not normally upward reduction but downward reduction that is desired, resulting in a physicalist ontology. Downward reductionism, here often for short 'reductionism', is the epistemological process of explaining wholes by their parts. I use the *epistemological* notion of 'downward reductionism', roughly associated to the *ontological* notions of 'atomism', 'materialism' and 'physicalism'.

Although the generally reductionist research programme has brought a gain in downward consistency[947], three sorts of problems have to be faced and will be discussed subsequently. Firstly, the resulting physicalism provides us with an ontology which itself casts doubt on the materialistic assumptions on which it is built. Secondly, its premiss that wholes are nothing but their elements will be called into question. Thirdly, genetic reductionism, although originating from the same current of thought, comes in contradiction to strict downward reduction, and demands a different frame of thought.

b) Problems of Modern Physicalism with Traditional Materialism

If downward reduction (especially in its eliminative form) is strictly applied, we end up in an 'atomistic' physicalism. If a whole is nothing but its parts, an ecosystem is nothing but its organisms, a society nothing but its individual members, thoughts are nothing but neuronal activity patterns, a person is nothing but organs, these organs ultimately are molecules, molecules are atoms, atoms are hadrons, and hadrons nothing but elementary particles, then we indeed would have to concede, that there is nothing but elementary particles.

Such an understanding of part-whole relations seems to be the core of materialism, and particularly physicalism, which advocates that only microscopic physical entities (and some eternal laws of nature) are real. According to this view the whole is not only constituted by its parts, but it actually *is* its parts and *nothing but* its parts. This view has been linked to a 'billiard ball-concept' of matter, figuring matter as solid and independent bits. Although this concept was strongly inspired by physics, the confirmed concepts of modern physics (relativity and quantum physics) paradoxically have broken with this 'billiard ball picture'.

(1) The 'particles' of physics are not particles in the classical sense, opposed to fields of forces, but are themselves entities which have properties of both particles *and* waves. After the problem has arisen that light, traditionally a wave, also had properties of a particle (Einstein), it soon became apparent *vice versa* that matter could be described by wave equations (L. V. de Broglie, E. Schrödinger). Also experimentally this counter-intuitive wave-particle dualism can easily be made apparent. For example in two-slit experiments single electrons which have passed through slits could be detected individually at the end of their route (as particle), but it could also be shown

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[947] Mostly high level terms have been made consistent with low level terms. Though this is of course positive, it becomes, I think, one-sided if this is done at the expense of *upward* consistency, for example denying – without much resistance – the existence of whole strata, like the cognitive world (e. g. qualia).

that ‘particles’ each behave differently depending on whether one or two slits are open, as if each would have passed *several* slits (like a wave actually does). According to the so-called Copenhagen Interpretation (N. Bohr, W. Heisenberg), the orthodox view today, reality can be ascribed only to a measurement and the wave-particle dualism does not reflect an inadequacy in present scientific knowledge, but is in this sense fundamental reality. Hence, elementary ‘particles’ are ontologically no longer only understood as ‘billiard balls’, but also as waves and distributions of probability.[948]

(2) The Uncertainty Principle (Heisenberg) states that it is impossible to precisely specify certain quantities simultaneously, like the position and the momentum of a particle. In contrast to classical physics an electron can no longer be said to be at any precise point at any given time. The Copenhagen Interpretation understood this indeterminacy ontologically. Despite a strong opposition to this interpretation (A. Einstein, M. Planck) this opinion is nowadays still favoured by most physicists.[948]

(3) The Uncertainty Principle likewise shows (and measures) the dependence of physical facts upon observation.

(4) The finding of new elementary ‘particles’ is an ongoing process. In the eliminative-materialistic sense it is not clear (and even improbable) whether today's elementary particles, and hence the basis of our ontology, does strictly speaking ‘exist’. Moreover, in principle it is not clear whether there *is* an explanatory bottom, a level of basic elements, which could ever be reached.

(5) $E = mc^2$ expresses the equivalence and, in principle, even the convertibility of energy and matter.[949]

(6) According to the theory of relativity the distinction of particles and space could not be sustained. Particles influence the space in which they move.

If we accept the truth of modern physics and dismiss the ‘billiard-ball’ model of matter, it may still not be logically necessary to abandon materialism and (eliminative) downward reductionism as well. But, I think, in several respects they lose most of their intuitive appeal:

(1) The concept of fields is not materialistic. It is doubtful if a resulting ontology where ‘matter’ and energy are convertible and where ‘matter’ is not only described by particles but by waves, probability distributions or fields, should still be called a *materialistic* position. Although it is of course possible to stipulate the definition of matter in a new way, I think this is not reasonable from the vantage point of the history of thought. The concept of fields is in my understanding rather reminiscent of Antique *hylemorphism*, of the Aristotelian kind, than of pure materialism.

(2) The concept of higher strata would not be materialistic. Proponents of the ‘billiard ball concept of matter’ will be inclined to believe that the whole is nothing but its parts. Who alternatively thinks in terms of fields, forms or ‘*Gestalten*’ will presumably be rather inclined to think of wholes as something more or something

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[948] See e.g., C. F. v. Weizsäcker, *Aufbau der Physik* (1985), pp. 490 f., 526 f.

[949] Also the less intuitive aspect of this Einsteinian prediction recently has been confirmed. In a Stanford particle accelerator a huge amount of energy was used to create matter (less than one atom). U. Schnabel, *Warum ist etwas?* (1997).

different from their parts. In this view it appears more appropriate to understand properties not only as being determined by the parts, but by their structure. Bohr, for example, in regard to two-slit experiments has always stressed the particle-wave individuality, which could not be decomposed into parts. This still may not be conclusive for an ontology of strata above particle physics. Additionally, the particularly modern physical theory of synergetics has favoured properties on the level of whole systems (H. Haken). It is doubtful whether a position which allows such higher partly autonomous explanatory levels, can still be called 'materialistic'.

(3) Scepticism concerning the 'thing in itself' is rather associated with theories opposed to materialism. In regard to epistemological questions materialism is at least historically correlated with realism. But modern physics rather appears to oppose any strong version of realism. If we accepted the physicalistic belief that physics is cardinal also for epistemology, then the uncertainty principle as well as doubts about the indivisibility of 'elementary particles' (and thus about their reality) would, I think, support at least a limited scepticism concerning the 'thing in itself' ('*Ding an sich*'). But a sceptic attitude towards our empirical knowledge has particularly been a hallmark of idealism.

(4) Matter is in an epistemological sense not simple. Materialism historically tried to base our philosophy on obvious experiences of the physical world. Modern physics at a first glance is a paradigm case for the success of a research programme of exhaustive downward reduction of complexes into simples. But the conception of a simple idea and of a simple ontological entity has become dissociated. The search for ontological simple indivisible entities actually resulted in concepts of entities which are epistemologically not simple, but complex in the sense of being non intuitive. In this sense materialism has lost the advantage of epistemological simplicity.

(5) The actual complexity of the world casts at least a pragmatic doubt on the full feasibility of the materialistic research programme. Even if it would in principle be possible to explain every whole completely in terms of its parts, this programme of reduction might get into difficulties. Not even the three body problem is exactly solvable (not even in the relatively simple mathematics of classical dynamics) and only a single drop of water contains more than a million million billion atoms.

c) Logical Problems of the Modern Understanding of Substance – Is a Tree a Million Matches?

The scientific question of reductionism in the 21st century is bound up with very old philosophical difficulties, concerning the concepts of *substance* and *accident*. The concept of *substance* had already been central in Antique and scholastic philosophy. In its Cartesian twist it became crucial to the modern era. Today the concept is still with us, for example, in the search for elementary particles or single 'egoistic' genes.

Substance traditionally has been regarded as (the concept of) a being which does not need another (concept of a) being for its own existence. A substance is unchangeable, indivisible and independent. It is what is constant and what continuously underlies the changing flux of phenomena. This is the core of the notion throughout two and a half millennia. (In a way this is the unchanging substance of the notion substance.) This is already found in Plato's concept of underlying eternal forms or 'ideas'. Equally Aristotle regards substances mainly as the underlying form (*eidos*) of actual beings.[950]

Also *Descartes' notion of substance* retained these meanings, but was not understood in the sense of *causa formalis*, but more and more in the sense of *causa materialis*. I will call this understanding of substance the '*modern understanding*', because its predominance starts at the beginning of modern philosophy with the Cartesian notion of *res extensa* (although substance was still sometimes understood differently). The concept of *res extensa* led to the 'billiard ball' model of simple bits of matter and to downward reductionism. Now the concept of substance denotes unchangeable elements constituting a whole, strictly speaking, only the smallest eternal bits of matter. This modern understanding of substances can be spelled out as the complete immanence of properties of the whole within its single material parts. Elements are defined not only historically, but also logically prior to the whole, and they are assumed independent and not defined by the relation in which they are involved. In such a world there *are*, in principle, no new wholes, since there are no wholes. There are only new configurations.[951] But configurations do not have any causal impact themselves.

Eliminative Downward Reductionism transposes this ontological idea to epistemology. The whole has no own (relational) properties, which could not be explained by properties of the single elements.

This modern understanding of substance could be regarded as the fundament of ontological or methodological individualism and atomism, present in many areas of physics, psychology and economy etc. Without getting involved in this topic in detail, this philosophy seems to me to be even embedded in some seemingly neutral instruments, for example classical test theory which presupposes the independence of all test items. In our context this modern understanding of substance has a pivotal role for the gene-Darwinian focus on single genes (➲ pp. 138).

In this context, the current *debate*, concerning the question of *eliminative materialism and reductionism versus emergentism, fulgurationism*[550] *and supervenience*[952] is of interest, but a full treatment of this lively dispute, mainly concerned with the mind-body problem, would have extended the scope of this work. Moreover, it appears to me that most disputants unanimously start from a modern understanding of substance (as *causa materialis*) and only discuss whether systemic properties are acceptable on this basis. Often the presupposition that there are constituting elements is not questioned. Instead it is only considered whether there are emergent properties, what character

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[950] Aristotle, *Metaphysics*, 7th book. (Whether this *eidos* is something individual or general remains an open question.)

[951] L. Wittgenstein, *Tractatus Logico-Philosophicus* (1921/1922), 2.027, ➲ footnote 785.

[952] See, for example: E. J. Lowe, *Causal Closure Principles and Emergentism* (2000). J. Kim, *Mind in a Physical World* (1998). A. Beckermann, *Supervenience, Emergence, and Reduction* (1992). J. Kim, *'Downward Causation' in Emergentism and Nonreductive Physicalism* (1992). R. v. Gulick, *Nonreductive Materialism and the Nature of Intertheoretical Constraint* (1992). W. Krohn, G. Küppers (Ed.), *Emergenz: Die Entstehung von Ordnung, Organisation und Bedeutung* (1992). J. Kim, *The Myth of Nonreductive Materialism* (1989). P. Bieri (Ed.), *Analytische Philosophie des Geistes* (1981). J. A. Fodor, *Special Sciences (or The Disunity of Science as a Working Hypothesis)* (1974).

such properties might have and whether they could have causal relevance (downward causation).[953]

My discussion of this problem starts from the opposite direction. It is not the possibility of the existence of emergent properties, but the possibility of the exclusive existence of basic elements (substances in the modern sense) that is questioned. But, first I have to make clear why there is a problem at all because the intuitive concept of emergent properties appears questionable, of one starts with the modern understanding of substance.

Emergent properties prima facie appear to be unproblematic. If elements are combined, they might form new relations and we might experience a new phenomenon. This holds for all sorts of subject areas. For example, if two people meet, they have the possibility of chatting; but – unsurprisingly – neither of them could (if they are sane) chat on their own.

This has also been stressed by synergetics, a new school or discipline of physics, which in my opinion implicitly modifies the modern understanding of substance.[954] We take one class of the ontologically simplest bits of matter as an example. Three quarks (or antiquarks) could form a hadron (or antihadron), the smallest compound bits of matter. An example of a hadron is a proton or a neutron. The system of a hadron has the property to be in different energetic states, although the single elementary particles do not have this property.[955] On the next level of complexity, an atom, built by up to 350 constituting parts (protons, neutrons, electrons), has again many new properties. New properties may not only emerge by adding new elements to the system, but also if a mere relational change of an identical set of elements occurs.[956] This becomes apparent e. g. in the different properties of physical isomers (nuclei, which are identical in regard of their *number* of protons *and* neutrons, but have a different radioactive decay) or in chemical isomers (molecules, which consist of the same chemical elements, but whose atoms are arranged differently). But the phenomenon of structural properties seems to be even more general. I think, one might also conceive phase transitions in this way, e. g. the transition of H_2O from ice to water to gas, or in principle also any chemical reactions. In all cases the elements

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[953] But, for example, ➲ footnote 1069.

[954] H. Haken is the nestor of synergetics. See his *Synergetics, Nonequilibrium Phase Transitions and Self-Organisation in Physics, Chemistry and Biology* (1983). There is also a Springer series on synergetics published by him. K. Stierstadt, *Physik der Materie* (1989), is an excellent textbook on physics in general, written from the viewpoint of synergetics.

[955] Epistemologically hadrons are even prior to quarks, not that they have been known earlier, but in the sense that Quarks could never be observed themselves. We only observe that hadrons get into different energetic states and infer the existence of quarks, because we have to assume an internal structure of these hadrons.

[956] Moreover, one could distinguish two types of properties of a system: 'collective' properties, which build an average of the properties of the parts (e. g. compressibility of an ideal gas), and 'co-operative' properties, which are mainly determined by a certain interaction of the parts (e.g., polarizability).

remain (broadly) the same, only energy changes. Elements primarily change partners or change their structural position, but this results in completely different properties.

The appearance of new phenomena seems to be too obvious to be disputed, but the crucial question is how to explain the nature of these phenomena.

Eliminative materialism or downward reductionism can be seen as ontological or epistemological expressions of a position, both of which advocate (1.) that in principle there is nothing new[957] and (2.) that apparently 'new' phenomena should be theoretically completely explainable by their old elements. According to this conception society is nothing but its individual members and humans are finally nothing but basic material elements.

> Dawkins, distinguished radicaliser, populariser and philosopher of a gene-Darwinian biology, but not particularly well versed in philosophy itself, apparently regards downward reductionism as the only possible form of explanation.[958]

(1) The first of the above assumptions about the impossibility of newness could be stated in different words. The actual and changing world is not the real World based on eternal substances. This still mirrors the Platonic concept of eternal ideas (ειδος) and the scholastic distinction of a changing world (*mundus sensibilis*) and a real eternal world (*mundus intelligibilis*) (➲ p. 76).

Although an assertion of an impossibility of newness seems quite daring – especially after we have shown above the intuitiveness of emergent phenomena – I think there is logically, or at least heuristically, an argument in favour of this view. If we equate 'new' with 'unknown', and 'old' with 'known', then it should become obvious, that we always have to understand the *unknown* by the *known*, hence the *new* by the *old*. Any phenomenon which would be *radically* 'new', would not be *understandable*. Thus, the assumption that the new is in fact old (if we do not want to call it a miracle or actually give up trying to explain it) seems strangely to be a necessary precondition of any understanding (in a way, a truth *a priori*)[959]. Here I do not discuss this argument any further, which unites the traditional *and* modern conception of substance, but concentrate on the second position, which is specific to the modern conception of substance.

(2) The second assumption at first glance only restates aspects of the first. There is nothing new, the new is the old and the new has to be explained by the old elements.

But the second assumption almost silently introduces another aspect, which I shall oppose. Now, the new should not only be explained generally by the old or the known, but by old or known *elements*. We again face the modern understanding of substance. Substance is seen as composing bits of matter. *Causa materialis* has supplanted *causa formalis* – or, I think, one might also say *causa relationalis*. According to this modern understanding of substances there is eternal matter, but no eternal form or relation; a whole has no explanans apart from its elements. The form, the structure or the relations of the compounds are understood as being epiphenomena and

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[957] Cf.: R. Löw, *Die Entstehung des Neuen in der Natur* (1984), p. 58.

[958] R. Dawkins, *The Blind Watchmaker* (1986/1991), pp. 11-15.

[959] Cf.: I. Kant, *Kritik der reinen Vernunft* (1781/1787) '*Grundsatz der Beharrlichkeit der Substanz*' and A 206/B 251.

conceptually have to be woven separately into each element composing that compound. Positively this makes causes locatable. But is a conception, according to which *all* phenomenal properties are reduced to separate *basic* elements, viable?

With this question we come back to the task (instead of arguing positively in favour of higher-level explanations) of challenging the assumption that reality is in principle understandable in terms of basic elements.

In the following argument I aim to show that such a conception is not free from fundamental difficulties. I shall argue that it is impossible to explain an apparent property, apparently given on the level of a system, only by referring to its constituent elements (substances in the modern sense), without making use of notions like form, relation or higher-level explanations.

If we were to collect all compounding atoms of a human, we would of course not yet have created a human. A supporter of *causa formalis* may interpret this simple fact as support for the conception that not only matter but also form is a necessary causal factor. A supporter of an approach exclusively based on *causa materialis* would of course not directly surrender. Whereas the former would argue that the form or, here understood synonymously, the specific relations between the elements have an independent role in explanation, the latter would have to build the confining conditions under which a 'higher' property appears into the concepts of each basic component.

But if one tries to do this, an aporia of reductionism becomes apparent. The confining conditions for an element to produce a certain property are necessarily related to other entities, to the constellation of the relevant system. The properties of water become apparent only if oxygen (under certain conditions) builds a compound with hydrogen atoms. The relation can not be eliminated.

A relation *R* is a two place predicate which has to connect at least two entities, *a* and *b* (or the concept of these entities). The reductionist might argue that it is possible to restate the property *P* of the relation *Rab*, on the side of entity *a* with a proposition, like 'the entity *a*, if in a certain relation *R* to *b*, has a certain property *P*', and on the side of entity *b* with the proposition 'the entity *a*, if in a certain relation *R* to *b*, has a certain property *P*'.

I argue that according to such a redefinition, both entities, *a* and *b*, would, against our intention, not be defined as substances in the strict sense any more.

(1) As we have seen, it is a crucial aspect of the notion of a substance that it is '(a concept of) a being which does not need another (concept of) being for its own existence'.

But the redefinition of the entities *a* and *b* does not eliminate the relation. The relation is still mentioned in the definition of the entities as a constraining condition for showing certain properties. Moreover, now *a* would even need to incorporate *b* within its own definition! Oxygen, for example, would be defined as an entity which, if in a certain relation to two hydrogen atoms, shows the properties of water. Thereby, the entity *a* is not at all defined independently, but it is *by definition* related to the other entity *b*. Furthermore the entity b is in turn also related to *a*, and this proceeds *ad infinitum*. This implies that each definition would become self-referential, since the entity which is used in the redefinition (a part of the *definiens*) is in turn related to the entity which is to be defined (the *definiendum*). Self-reference is in my view an interesting property, but it is definitely an unintended one from the viewpoint of a reductionist. However, the idea of the independence of the substance is not fulfilled. Hence, an understanding of substances as independent basic elements appears to me generally to be self-refuting and inconsistent.

(2) A second aspect of a substance is usually that it is simple. The simplicity of unrelatedness has been discussed above. Reductionists with only a weaker concept of substance (perhaps claiming that alternative concepts also end up in aporia) may still refer to a *prima facie* appeal to simplicity. It appears at least epistemologically simple, if all properties are located in final elements. Although we of course daily make use of the concept of components (just as we make use of wholes), I want to show that a radical application of this idea is not reasonable. Taking up the line of argument from the last paragraph, a thorough reductionist redefinition of entities, would paradoxically finally force us to incorporate the whole world into the definition of each entity. Oxygen builds compounds not only with hydrogen but with many other elements, which would have to be incorporated into our definition. Not enough, these compounds would have to be extended to large systems to integrate, for example, properties of humans, like walking or thinking, in which water definitely somehow plays a role. One would have to consider all such higher-level properties. Even the sober biologist Mayr mentioned that a through reductionist account – instead of accepting emerging entities – would, strictly understood, force its advocates to adopt pan-psychic or hylozoic theories of matter (if they do not simply deny phenomena like thought).[960] It would also follow, that all elements and constraining relational conditions which are involved in producing such properties or processes would have to be incorporated into the definition of oxygen as well. In a general downward reductionist epistemology all other elements would also have to be defined likewise. Hence, if a particular element was not yet *directly* part of this definition of oxygen, it would definitely in a secondary, tertiary etc. way (via the definition of hydrogen etc.) be integrated. Hence, it follows from taking reductionism to its true conclusions that the whole world – with all its elements and its higher properties – would finally have to be incorporated into the definition of each single element!

Such a result would be totally opposed to the original idea sought after by the independent definition of basic elements. Concerned with the aspect of simplicity, we see how the apparently beautiful simple concept of (downward) reductionism, explaining all phenomenal properties of 'higher' systems in terms of 'lower' systems, quickly degenerates into a highly complicated and inconvenient philosophy. Even if it were in principle possible to transfer all properties of the known compound entities into the concept of elementary particles (which is of course actually not done), then these concepts would become loaded with an infinite bulk of conditions under which potential properties are shown.

(3) Finally, it follows that the concept of the unchangeability of substances can not be sustained. I am not concerned with our factual knowledge that hydrogen itself only becomes stable in a certain stage of the evolution of the universe (one may circumvent

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[960] E. Mayr, *The Growth of Biological Thought* (1982), p. 64.

this problem by referring to currently basic elements). I am concerned with the rather logical problem that the relationships, which are part of our definition change in time, as nature, history and also our knowledge of these processes develops. For example, the definition of the basic components of genes, the nucleotide bases adenine, guanine, cytosine, and thymine, would not only have to integrate the possibility of replication, but also sexual reproduction (of which it builds the basis) as well as this present thought of mine.

In conclusion, an ontology built exclusively out of single substances – in the sense of *causa materialis* – bears huge difficulties. Three defining criteria of elementary 'substances' could not be sustained. Above all (a), a material substance seems not to be definable without relation to other entities, it could thus not said to be independent from other entities. Secondly (b), the resulting view seems far from being epistemologically simple, and thirdly (c), the definition of a substance changes throughout time.

It is not within the scope of this work to elaborate a positive alternative account on this general level. Here it should be enough to have pointed out that metaphysical problems weight heavily upon the seemingly simple modern notion of substance and its epistemological counterpart of downward reductionism. To assume from the outset that the whole is nothing but its parts, is at least no less problematic than assuming properties on the level of a system. Although not trying to elaborate an alternative on such a general level, in specific areas I still shall contribute in the further course of this work to the rehabilitation of a modified Aristotelian aetiology, by introducing some ideas which may help to render *causa formalis* more acceptable. Nevertheless, I want already here, without making use of explicitly Aristotelian concepts show how the concept of downward reductionism as the only possible form of explanation might be transcended.

> I conceded that one may need to explain the new by the old, the unknown by the known. But given this premiss, how can one conceive an explanation which is not completely downward reductionist. Although (downward) reductionism is an important way of explaining the new by the old, there are, I think, other forms of explanation as well.
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> I want to distinguish at least four types of explaining the new by the old. The first two types could be called 'analyses' since they are concerned with a closer scrutiny of the details of the entity in questions. Besides an (a) analysis of elements (downward reductionism), there is, I think, also an irreducible (b) analysis of the relations of these elements. The other two types of explanation may be called synthesis, since they explain by taking the larger context into account. There is (c) a synthesis with analogous (external) cases and (d) a synthesis with external conditions or causes. I do not discuss whether these explanations are types or aspects, or whether in an analyses synthesis always plays a part and vice versa, etc. I only want to give an impression that there are aspects of an explanation going beyond downward reductionism.
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> Additionally I give examples for each of the two latter points, which may appear more opaque: (c) Chemistry, a field which has often served to provide examples for downward reductionism, could also illustrate the concept of a 'synthesis with analogous cases'. Chemistry has not only derived its knowledge of the elements by an analysis of its components, but *also* by analogies with other elements, which had become systematised in

> the periodic table (1869/1870 by Mendeleyev and Meyer). Only from such analogies could 'new' elements and their properties be predicted. (d) An example for a 'synthesis with external conditions' could be the 'Coriolis force'. If we must explain the direction of a whirl in a wash-basin we could only reach a sufficient understanding, if we actually take the rotation of the whole earth into account.
>
> The consequences and problems of such an alternative account could not be accessed here. I only proposed this classification to show that there are types or aspects of explanation which are often ignored by staunch reductionists.➲[958]

d) The Inconsistency between Biologism and Physicalism – Genes or Information versus Quarks?

This section firstly sets out to show that a gene-ontological approach, despite being biologically downward reductive, is itself in contradiction with strict downward reductionism, i. e. physicalism. Secondly, the notion of a replicator is introduced as the specifically gene-Darwinian justification for stopping reduction at the explanatory level of selfish genes. Thirdly, closer scrutiny of the notion of a replicator reveals that the very notion of a replicator – against the intention of the gene-Darwinians – undermines a materialistic account, and proposes an ontology which is built on form and information as opposed to matter. [961] I shall argue that the resulting informational or semiotic ontology paradoxically undermines the inner-biological reductionism of gene-Darwinism from which this view derived.

(1) Biologism on the one hand is inspired by general downward reductionism, defining cultural phenomena in terms of biological phenomena. On the other hand biologism comes into *contradiction* with thorough downward reductionism, which would finally result in physicalism. In principle, downward reduction should not stop until it has reached the lowest possible level of explanation (➲ pp. 248 f.). Leaving my earlier general objections aside, taken as a general philosophy, *any* wholes would have to be determined in terms of their parts, till we reach the final a-toms, the smallest non divisible entity, or, still more modern, the elementary particles of physics.

The ambivalent relation of biologism to downward reductionism also holds for gene-Darwinism as a prototypic biologistic approach (➲ pp. 138 f., 191 f., 245 f.). Advocates of a gene ontology on the one hand are notoriously enthusiastic about substance reductionism: ecosystems, societies, gene-pools, organisms and genomes are regarded as mere epiphenomena, and single genes are regarded to be essentially the only real biological (and sociological) entities (➲ pp. 35 f.; 264 f.). On the other hand this downward reductionist account suddenly stops at the 'bottom' of the biological sphere, at the explanatory level of single selfish genes. Despite a particularly strong inner-biological reductionism, this approach is still inconsistent with thorough reductionism. Later on, the assumption of genes as the only unit of explanation, denying all larger units, will be challenged (➲ pp. 264 f.). Presently, we have to grapple

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[961] This section was first presented as a talk at the post-graduate philosophy seminar (*eidos*) at the University of Durham under the title: *Gene-Darwinism, Form and Information* (22nd Sep. 1999).

with the problem of why genes themselves are not too *large* as units of explanation, provided that one favours a downward reductionist account.

An advocate of gene-Darwinism might object to this reproach for being inconsistent with thorough downward reductionism that he or she still subscribes to downward reductionism, but that any reduction has to be done in pragmatic and viable steps. In the long run, the gene will also be reduced to biochemistry, etc.

I would oppose such an interpretation of their enterprise, since it is apparently inconsistent with the claims and scientific practice of this school. I think, gene-Darwinians truly believe in the existence of genes. Normally promoters of this approach, as we saw, contrast the reality of genes with the epiphenominality of genomes, groups and ecosystems. This contrast would not be reasonable if genes were ultimately supposed to be as unreal as groups are believed to be. The entire debate concerned with the unit of selection would be misconceived, if in principle all levels were not real anyway, i. e. there would finally be no entity which is replicating or which is being selected, but only chemical reactions.

Additionally, assuming that there were no theoretical framework in biology, it would not be obvious why so much attention should be given to genes, any DNA molecules. Plain downward reductionism should proceed continually. If one only wanted to proceed in the reductionist quest pragmatically step after step, one would also from time to time use levels above or below the level of single genes.

> Explanatory levels above the level of the gene (e. g. individual animals, genomes etc.) are indeed sometimes employed, but these explanations are consistently used as provisory or short-cut explanations only. I see also no general tendency that in this paradigm explanations are increasingly given on a *sub*-genetic level. Gene-Darwinians (though seldom geneticists) do not, of course, deny the existence of bio-chemical or subatomic reactions, but they do not focus on them. They might use a 'deeper' explanatory level to explain aspects of the gene-level above (for example to show how X-rays could cause random genetic mutations), but they will always be interested, not in the chemical reaction itself, but in the higher explanatory level of the survival of genes.

If advocates of gene-Darwinism only claimed that larger units have to be explained by smaller ones, resulting in physicalism, and there had been a book called 'The Selfish Gene Pool', 'The Selfish Genome' or 'The Selfish Quark', this would presumably not have triggered the same paradigm and the same dispute.

I conclude that advocates of gene-Darwinism do attribute to genes a stronger degree of reality than would be justifiable on the ground of plain downward reductionism.

(2) Now it is important to show that supporters of a gene-ontology might, even within their generally reductive framework, have reason to stop reduction at the level of what is called replicators.

Whatever such an explanation might look like, I think, one cannot deny that any such explanation is by definition in contradiction with an exclusively downward reductionist approach. This exception may undermine the downward reductionist approach and it would become more plausible that explanatory levels above selfish genes became accepted. Still it would also be possible – albeit implausible – to accept only *one* new entity or process which could not be reduced to physics. We have to look for an explanation which might justify the special treatment of 'selfish genes' without already at first glance, being incoherent with the remaining reductionist attitude of the gene-Darwinian paradigm.

Many gene-atomists in fact do not ponder questions of this rather metaphysical kind: *why* reduction should stop at this explanatory level, or *why* it is at least pragmatically convenient to stop at this level. They – as we have seen – usually simply proceed in this way.

In my opinion, the extraordinary centrality and the irreducibility of the gene in gene-Darwinism is linked to certain aspects of the notion of a replicator. "What is important about the gene is just that it has a certain combination of logical features. It is a replicator".[962] Dawkins in particular has made the importance of this notion explicit. I agree with Hull, that Dawkins has in this regard committed an act of metaphysics.[963] Dawkins defines a replicator as "any entity in the universe which interacts [...] in such a way that copies are made".[964] The notion of a replicator is, I think, indeed general enough (like Aristotle's notion of *anima*), to also serve as a criterion to divide the inanimate world of physics and chemistry, from the animate world of biology and sociology.

> It may be odd to assume that Dawkins, a renown ardent downward reductionist, should be regarded as a defender of the autonomy of biology. I do not know, whether he ever explicitly argued in this way, but his writings, in my opinion, suggest that he would have to support such a view, especially his emphasis on and his definition of the notion replicator, but also his neglect of physical and chemical evolution.
>
> Anyway, given that gene-Darwinism has to justify an explanatory level of genes above physics, I think, no other argument is provided by this paradigm. Hence, in my view advocates of a gene-ontology – if they were more concerned with these philosophical topics – would have to argue this way.

Before we come to *justify* why a replicator could count as unit of explanation, not reducible to chemistry or physics, we should pause and consider whether the notion of a replicator might be a one-sided starting point of an inquiry. Although the main part of this work is dedicated to criticising gene-atomism and germ-line reductionism, I generally agree that the metaphysical (abstract and general) notion of a replicator is helpful for establishing the autonomy of the life sciences. Nevertheless, I concede that the notion of a replicator has a downward reductive leaning.

> Even if we were to adopt my later informational interpretation of a replicator as the basis for reconstructing the autonomy of the life sciences, we should be aware that this starting point still may have a *reductionist leaning*. A replicator – and hence of the origin of life – is normally imagined merely as being a molecule, presumably RNA or DNA. The concept of a replicator is normally a single entity and not a system or a part of a larger whole, say a cell.[965] A definition of life based on replicators not only excludes stars and volcanoes from the

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[962] J. L. Mackie, *The Law of the Jungle* (1978), p. 459.

[963] D. Hull, *Units of Evolution: A Metaphysical Essay* (1981), pp. 30.

[964] R. Dawkins, *Replicator Selection and the Extended Phenotype* (1978), p. 67. See: R. Dawkins, *The Selfish Gene* (1976/1989), p. 15.

[965] Cf. e.g., Ch. v. Guttenberg, *Biologie als Weltanschauung* (1967), pp. 63-64.

> animate world (a consequence we may welcome), it may also have a general tendency to neglect larger systems like ecosystems etc.
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> I think it would make a difference to take the notion of a metabolism as starting point for the life sciences. The Nobel laureate M. Eigen has proposed the concept of a hypercycle with a stronger focus on systems, on the structure of the phenotype and maybe even on change without proliferation. I do not want to exclude the possibility, that the two concepts may be made coherent.[966] Since I am trying to transcend gene-Darwinism from within, I only mention this slightly different starting point, without elaborating upon it.
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> Also in regard to processes, the notion of a replicator is in my view linked with a position, which takes Darwinian processes at least as starting point (➲ the following argument b) and hence might exclude a strong understanding of developmentalism.

For the time being we may ignore this possible one-sidedness. Why should a replicator count as a unit of explanation, not being reducible to chemistry or physics? In my view there are two reasons. The first reason (a) would relate to properties of wholes, and states a position quite obviously opposed to downward reductionism. The second reason (b) may closer resemple the actual reasons why gene-Darwinians hold this position. However, it replaces the problem rather than solving it. Linked to this, it will also be shown why the notion of a replicator undermines a strict materialist account.

(a) A replicator, in my view, is a *system* of chemical components, and relations between them, with a certain relation to its surrounding. Only the whole system with its relations has the property of copying itself. Simpler entities, even, for example, 'organic' molecules do not have this property of copying themselves. My general critical account of radical downward reductionism has already been given, and does not need to be repeated here

(b) A replicator, in the view of gene-Darwinism, may have acquired its special status, because of its link with *Darwinian processes* (➲ pp. 218 f.).[967] Despite my critical stance towards any *exclusive* Darwinian metaphysic, I have to draw attention to the fact, that the simplest notion of a replicator is, I think, indeed linked with the simplest notion of evolution, i. e. Darwinian evolution. Imagine the simplest thinkable atomistic replicator in the primeval soup. This replicator, like every replicator, is defined by the process of copying. But this first replicator will copy either quickly or slowly, accurately or inaccurately, with huge or little variance, and hence this process of proliferation is, I concede, as blind as possible (on blindness ➲ pp. 368 f.). The proliferated replicators lack (nearly) any structure of their own and are not part of a larger whole and could, as far as it is possible, be regarded as being *externally* selected. This simple notion of a replicator leads within the limits of even our strict definition, to what we have called a Darwinian process (➲ pp. 358 f.).

Following this line of argument, regarding the existence of a replicator as the dividing line between biology and chemistry appears obvious. Gene-Darwinism,

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[966] Cf.: R. Dawkins, *The Selfish Gene* (1976/1989), footnote on p. 269 relating to p. 14.

[967] Also R. Dawkins points out (without elaborating it) that the notion of a replicator implies the notion of natural selection, *River Out of Eden* (1995), pp. xi-xii.

implicitly following this argument, accordingly regards the resulting property of evolving replicators and the corresponding process of natural selection as irreducible topics of biology.

Although I also want to draw this conclusion, I think that this quite Darwinian argument, defending the reality of replicators, leads it on further, and finally undermines its own roots. The argument hinges on assumptions, which, if spelled out in detail, undermine the materialistic legacy of this approach.

> Firstly, even if we accepted the presupposed evidence of the existence of Darwinian processes (as I actually do) the above argument has only replaced the problem rather than solving it. In a *regress* a gene-Darwinist replaces the problem of the irreducibility of a replicator to mere matter in motion by the problem of the irreducibility of natural selection to mere matter in motion.
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> Secondly, given that the notion of a simple replicator implies a Darwinian process, it does not follow that the other way round the existence of Darwinian Processes also implies the existence of simple replicators. This depends on how both notions are defined. It might indeed be reasonable to define these notions in a way that they imply each other. A disadvantage of a resulting strict definition of Darwinian processes might be that drops of water and planets – also somehow 'evolving' – would be excluded from the scope of a Darwinian metaphysics. However, such a definition, in my opinion, would, surprisingly, tend to undermine Darwinian process-monism. Each new 'higher' biological object, accepted in our ontological inventory, while refuting pure gene-atomism, would be a candidate to undermine Darwinian process-monism as well.
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> Thirdly, if we had accepted the equivalence of a simple replicator and a gene-Darwinian process, the notion of a Darwinian Process emphasises – besides blind variation – a second step of external selection. This reference to the external world (though a relationship in a quite limited sense) may be crucial to why this process could not be reduced to its internal parts. In my proposed classification of explanations this would be a 'synthesis with external causes' (type 4). But if this is the hidden reason to resist downward reduction in this specific case, this reference to external causes may also be necessary for many other explanations, undermining downward reductionism generally.
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> Fourthly, this kind of external relationship appears not to suffice, neither to sustain the irreducibility of a replicator nor to characterise a replicator. External selection alone, in the mere sense of surviving or not surviving, being or not being (depending on the external circumstances), could also be applied (in an almost tautological way) to drops of water and planets. Hence, this either undermines the discussed account, or we need an additional characterisation to differentiate between drops of water and replicators.

Following this line of argument, the notion of a replicator, although itself intimately linked to gene-Darwinism, either directly undermines gene-Darwinism or requires that we find another aspect of the notion of a replicator, which renders genes irreducible, but does not transcend gene-Darwinism. In the following subsection I show that the other aspect of the notion of a replicator, the reference to the sameness of the copy, generally tends to undermine a materialistic approach.

(3) In the following section it is shown that the concept of a replicator, which was needed to justify stopping the eliminative quest at the level of the gene, involves (a) the concept of a catalyst, i. e. a concept of an entity which changes the probabilities that a certain entity emerges and involves (b) the concept that the copied entity could

not only be described in material terms, but that the identity of the replicator and the replica could only suitably be described in terms of form (*eidos* in a very simple rather Aristotelian than Platonic sense) or information.

We take Dawkins' definition that a replicator is "any entity in the universe which interacts [...] in such a way that copies are made"[964] as a starting point. But our task is not finished by giving this definition; in my opinion the essential metaphysical quest only starts at this point! What property of a replicator makes it such a special entity that we are entitled to take it methodologically, or even ontologically, as a reason for an autonomy of the life sciences? We will (a) discuss what it means to 'interact' and (b) what it means to 'be a copy'.

(a) What do we mean in our definition of a replicator, when we are concerned with its first defining aspect, that of interaction?

The first explication of this term would be that by interaction we mean some causal interrelation of two objects. (Here I will not dwell on the Humean problem of causality.)

But, by interaction, we, of course, do *not* mean the mere existence of a certain entity at the same time its copy emerges. This is not as trivial as it seems, because we know since Newton that the gravity of any body interacts in principle with every other body. Gravity as a special form of interaction diminishes over distance, but is in principle not limited by distance. But if we accepted gravity as an interaction in our sense, any structural identical entity (as far as it has mass) would count as a replicator, when a new structural identical entity emerged (existing already before, within the distance of the speed of light). Obviously, such a proposal would be absurd. But why? Presumably, because *an* interaction is not enough to count as interaction proper. An extremely weak long distant influence within other, almost infinite, stronger influences is not enough.

Moreover, we would neither accept all and every case of chemical interaction, taking place as close distance electromagnetic interaction. As a thought experiment we can look at a real experiment. Since the work of F. Wöhler (we also may think of Stanley Miller), we know that 'organic' molecules like urea can be produced in normal chemical reactions. Urea, chemically speaking $CO(NH_2)_2$, consists out of the 'inorganic' components, two times N, five times H, one C and one O. We assume that in Wöhler's test tube another molecule of $CO(NH_2)_2$ 'by chance' was around already when the new molecules of $CO(NH_2)_2$ emerged. We assume that this first molecule of urea even chemically interacted with one of the inorganic components, say with the hydrogen, shortly before a new molecule of urea was composed. Would we then be entitled to call the first molecule a replicator? Would we be entitled to deny that Wöhler has himself produced 'organic' molecules out of inorganic ones and to claim that it was the 'replicating' organic molecule which has been in the test tube before? No, I think not! If the interaction was not 'essential' for the emergence of the new molecule of urea, and (expressed the other way round) if the emergence of this molecule had taken place 'independently' of this old molecule of urea anyway[968], the interaction of these two molecules, would not qualify the first molecule as a replicator (and hence F. Wöhler's honour remains undiminished).

Hence, the actual presence of a causal interrelation is only a necessary, but not a sufficient condition for qualifying as an interaction proper. The sufficient condition is that a replicator by its presence has (to a relevant extent) to *enhance the probability of the emergence of the identical entity* (the replica). The notion of a replicator demands that this entity is 'actively' contributing something to this emerging new whole. Without the existence of a replicator, the probability that single elements become compounded into the entity in question, simply by hitting on one another (or what one may call chance), would be lower. In short, a replicator is an entity which has the property that its existence enhances (perhaps without changing itself) the probability of the emergence of the (structurally) same entity.

Although the aspect of 'enhancing the probability of an entity to come into existence' appears to me to be philosophically particularly interesting, this is obviously not an exclusive property of replicators. In chemistry any catalyst also has the property of altering the probability, the rate or the velocity of a reaction (without itself undergoing any essential chemical change).

In this philosophical work, I am not interested in chemical catalysts for their own sake, but rather in a generalised notion of a catalyst, i. e. any entity which changes the probability of the creation of other entities, without being altered itself. By introducing such a notion we, no doubt, enter upon interesting but difficult ground. Besides the chemist's endeavour to look for the reactional mechanisms of catalysis, a metaphysics of catalysis appears to be needed.

> Which entities could count as catalysts in the generalised sense? What does it mean to change the probability of the elements to build a component? How could this notion of a catalyst be made coherent with the deterministic understanding of causality of (classical) physics? Are we entitled to use in our definition of a catalyst the complex notions of probability and counterfactuals?

Back to our main line of argument. We have found that the notion of a replicator involves catalytic properties, to enhance the probability of the emergence of the identical entity. This appears to me to be in contrast to a simple notion of matter in motion. This also plays a role in the next section, where we focus on an additional property of replicators: unlike mere catalysts, such as enzymes, they are *self-referential.*

(b) The second notion which plays an important role in our definition of a replicator is the notion of a 'copy'. Besides interaction, this involves a notion of sameness.

Replicators are enhancing the probability that a copy is made of the *same* entity, which enhances the probability that a copy is made of the *same* entity, which enhances the probability that a copy is made of the *same* entity. Subject and object of this process of copying are in some respects identical. A notion of identity is

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[968] Whether we are entitled to argue in terms of counterfactuals or not is not my topic here. Our actual usage of the notion of a replicator entails such a complex concept.

needed, which links the subject and the object of the catalytic process. I am going to argue that even a notion of *informational identity* is needed, which would change the focus from matter to structure or form (Greek: *eidos*) and which, historically, has been almost the antithesis of matter (➲ pp. 69 f.).[969]

> The concept *information* should here be understood in a common sense way, and not be interpreted in the specified and specialised way of Shannon's information theory or of semiotics. Later on, I shall introduce the term 'formation' which is less burdened with given meanings (➲ pp. 316 f.).

But what do I mean by informational identity. For my purposes I want to distinguish two dimensions of identity: a) Selfsameness and sameness[970]; b) material and formal identity. The notions are made clear in the further course of the argument.

Obviously the notion of a replicator essentially involves something different from selfsameness. Herewith we mean that the replica is spatially distinguished from the replicator. The notion of selfsameness (material or formal) is already a precondition of any concept of an entity existing at different points of time! Hence, in regard to the first mentioned dimension the *differentia specifica* of a replicator is the catalysis not of the selfsame but of the *same* entity.

Does this already imply *informational* identity? Not necessarily. If we think of a replicator for example as merely a fragment of DNA, the sameness of form, structure or (in)formation – at this point used equivocally – seems to be inextricably linked with material sameness. The compounding elements, the nucleic acids, are the same in the replicator and the replica. Hence one might argue that the formal sameness is only due to the material sameness, or, put differently, that formal sameness is reducible to material sameness. Ockham's razor (i. e. theoretical parsimony) would demand us to abandon the additional notion of (in)formational sameness.

This objection would be invalidated if are able to give an example, where formal (informational) sameness is not entangled with material sameness, and hence could not be generally reduced to material sameness. Keeping up to Dawkins' generalised definition that a replicator is 'any entity in the universe which interacts [...] in such a way that copies are made', it is in fact easy to find such an example. In our *Lebenswelt* we are today provided today with a subject area which has become almost prototypic for the notion of information itself, i. e. the notion of software. A computer virus, a bit of software, obviously fulfils this general criterion for being a replicator.

> Our definition of a replicator implies that computer viruses are also alive, although of course not in a greater sense than a biological virus is.

A computer virus produces copies of itself in a computer network. Such copies could also be made to a compatible, but different, computer system, with a different operating system, different underlying semiconductors, and different material basis (like silicon, gallium arsenide, or optical circuits).

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[969] For a similar antagonist understanding of matter and information, see e.g., G. Webster, B. Goodwin, *Form and Transformation* (1996), p. 4. But cf. also G. C. Williams, *Natural Selection* (1992), pp. 10 f.

[970] In German there are the terms '*das Selbe*' and '*das Gleiche*' to express this distinction.

Based on this example, it should become clear that the essence of the property of copying is (or at least could be) the copying of the form, the structure or information, not that of its material elements. The notion of a replicator, does in principle not require the sameness of the underlying material elements! Hence, formal or informational sameness, opposed to the material one, does play an indispensable role in defining the notion of a replicator.

In conclusion, a replicator can be regarded as an entity which catalyses the building of an entity (i. e. it enhances the probability that such an entity is built) which is informationally, not necessarily materially the same as the replicator. Thereby we have in my view already left or transcended a strict materialistic ontology. In the dispute about universalia the nominalists have claimed that universals ("the sort of thing which can be wholly present in distinct individuals at the same time"[971]) are mere abstractions, which allow us to order intellectually the changing flux of experience. Formal sameness would normally be interpreted by a materialist as a mere nominalist abstraction (*universalia in intellectu*), whereas material sameness would be regarded as real. Opposed to this it has been shown that the property of form is required. Although I would concede that ontological and epistemological issues can never be completely disentangled ("Thoughts without content are empty, intuitions without concepts are blind."[972]), the need to introduce formal sameness appears to be rather ontological.

In any case it appears plausible that, if we should adopt an informational or semiotic metaphysic, it would undermine the reductionism of gene-Darwinism *within* biology and sociology. The notions of form and information may in this case also justify other levels of being. But although this becomes more plausible, it is not necessarily conclusive. At least in principle materialistic downward reductionism might be replaced by a similar 'informational downward reductionism'. Thus, in addition to our general criticism of reductionism, the following sections on gene-atomism (➲ pp. 264 f.), on germ-line-reductionism (➲ pp. 311) and on process reductionism (➲ pp. 333) will challenge more specific aspects of gene-Darwinism.

In conclusion, if gene-Darwinism tries to justify the actual stopping of its reductive quest at the level of single genes, it has to introduce the notion of a replicator. But this notion of a replicator, closely linked with gene-Darwinism, has been demonstrated not to be based on the notion of matter, but on notions of form or information. If this holds true, then an at least partly *informational or semiotic metaphysic* needs to be elaborated. On such grounds it might be easier to vindicate the existence of higher ontological levels, like organisms or groups, or even psychological states or culture.

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[971] J. Bigelow, *Universals* (1998), p. 543. According to Bigelow universals do not have to be 'universally' present in all entities, but they are "characteristically the sort of thing which some individuals may have in common, and others may lack."

[972] I. Kant, *Kritik der reinen Vernunft* (1781/1787), p. A 51/B 75. (➲ also p. 67).

8.2 Genetic Reductionism I: Gene-Atomistic Reductionism and Its Transcendence

Leaving the *general* problems of substance reductionism behind me, I will now discuss the *specific* problems of genetic reductionism, as advocated by today's gene-Darwinism (➲ pp. 138 f., 191 f.).[973] Genetic reductionism could be regarded as being composed out of two different reductionistic tenets: firstly, the *reductionism of gene-atomism*, the veneration of the single, independent, selfish gene; and, secondly, *germ-line reductionism*, an extreme interpretation of the Weismannian 'central dogma of molecular biology', an interpretation venerating the genotype and dismissing the phenotype as a mere vehicle.

If one follows a replicator-vehicle distinction[974], *gene-atomism* is a position that exclusively states that *single* genes are the *replicating* entities, and *germ-line reductionism* is the position that organisms, groups, species and ecosystems are *mere vehicles* of the true agents of evolution, the genetic replicators.[975]

a) Gene-Atomism – Empty or Wrong Claim?

Gene atomism claiming that there are no other ontological and epistemological levels despite the level of single selfish genes (➲ pp. 140 f.).

> From a historic perspective this view could be contrasted against essentialistic (➲ pp. 71, 92 f.), romantic (➲ pp. 82, 95 f.) and even Kantian biology (➲ pp. 80, 92, f.), which all emphasised that wholes are highly relevant for the existence or interpretation of parts. Additionally, gene-atomism also turns against other mechanistic accounts of evolution, like the evolutionary synthesis, which has largely focused on properties of populations (➲ pp. 127 f.). Today, gene atomism is a prominent view, but it is increasingly challenged by approaches which advocate many levels of evolutionarily relevant entities (➲ pp. 152 f.).

Gene atomism advocates that single genes, small genetic fragments, are the only real units of (biological) evolution. Different levels of replicators are discarded. According

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[973] This needs to be done cautiously, since some critics – though correctly recognising reductionism as a general hallmark of this paradigm – have sometimes slightly misinterpreted its specific type of reductionism. For example, L. Frith in *Sociobiology, Ethics and Human Nature* (1992), I think correctly, criticised the biologistic reductionism of sociobiology. But, firstly, she, in my view wrongly, attributes an individualist view to this paradigm (p. 150). The paradigm is indeed opposed to the existence of groups, but treats individualism only as an approximation of the truth; correctly the hard-core principle of gene-Darwinism, predominant in today's sociobiology, is the sub-individual selfish *genes'* viewpoint. Secondly, she states that sociobiologists treat family units in the same way as society and environments (p. 151). This also gives a too simplified impression. Although it is true that families like single organisms are seen in a nominalistic, reductionistic way, they are based on their relatedness, according to the theory of kin selection and understood to be much more real than other groups or ecosystems.

[974] For Hull's modifications and Dawkins' later extension of his own primordial terminology ➲ p. 219. The distinction itself will be discussed in the section on germ-line reductionism (➲ pp. 311 f.).

[975] R. Dawkins draws this distinction in a similar, but different, way, *The Extended Phenotype* (1982/1989), p. 82, sometimes a link of these two arguments becomes apparent, p. 95.

to gene-Darwinism it is essential that a unit of evolution or selection is a replicator (this guarantees its stability).[976] For the time being, we are not concerned with the replicator-vehicle distinction or the *phenotypic* versus genotypic debate, i. e. with the phene-versus-gene, individual-versus-genome, group-versus-gene-pool debate. Instead, we engage in the gene-versus-genome-versus-gene-pool debate, which is only concerned with the genotypic side.[977]

Are single selfish genes essentially the sole (biological) replicators? Or is it in principle possible to regard larger genetic units as replicators as well, like compounds of genes, whole genomes or gene pools of organisms, groups, species or ecosystems?

In traditional terms this could be reformulated as the question of what is the genetic 'substance' and 'accident' of evolutionary change. Gene-atomism, linked to the modern understanding of substance, seeks this substance of evolution exclusively within smallest genetic bits (➲ pp. 248 f.).

> The claim of the *selfishness* of small genetic fragments results from two assumptions. Firstly, according to what I have called the 'principle of egoism' (➲ e. g. p. 110), every substance (at least, if it has active powers) 'cares' only for itself. Based on this principle, one may generalise the term 'selfish gene' to any – active – substance and call them more generally 'selfish entities'. The second assumption of gene-atomism is that the only genetic substances are single genes. At this point we are only concerned with the latter assumption.[978]

I regard the gene-atomistic claim as either (1) empty or (2) wrong:

(1) The notion *gene* is microbiologically closely linked to the discovery of deoxyribonucleic acid (DNA). In that context a gene is conceptualised as a strand of DNA, a short pattern of information, coded in the simple alphabet of the nucleotide bases, adenine, guanine, cytosine, and thymine. According to this understanding a gene is frequently equated with a piece of three nucleotide bases (a triplet), which often codes an amino acid, those components from which proteins are build. It is also often restricted to those triplets, which actually code amino acids (codons). Sometimes a 'gene' also refers to a DNA-sequence which is the basis for an RNA-transcription or a polypeptide.

However, Dawkins and other protagonists of the gene-Darwinian paradigm, as we have seen, have favoured exclusively single 'atomic' genes as replicators.[979] Although this at first glance seems to be a radical claim – any larger genetic units, genotypes and gene-pools become excluded – it may well turn out to be an almost empty statement if the adopted definitions of a gene are taken into consideration.

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[976] E.g., R. Dawkins, *Replicator Selection* (1978), p. 69.

[977] According to R. Dawkins, one of the most passionate supporters of gene atomism, there may be a hierarchy of vehicles, not of replicators. He even claimed that the individual-versus-group debate is only concerned with vehicles and assumes that his gene-atomism – what replicators are concerned – is not questioned. Cf.: *The Selfish Gene* (1976/1989), p. 254; *The Extended Phenotype* (1982/1989), p. 82. Nevertheless, Dawkins, at least half-heartedly, discusses the question of gene-pool-selection in *The Extended Phenotype* (1982/1989), p. 114.

[978] Although the principle of egoism bears some truth, I do not regard it as being generally true (➲ pp. 418f.).

[979] But ➲ also p. 31.

In contrast to the microbiological understanding, a gene here is usually defined in evolutionary rather than primarily chemical terms. Williams defines a gene as "any hereditary information for which there is a favourable or unfavourable selection bias equal to several or many times its rate of endogenous change"[980]. Dawkins (referring to Williams) defines a gene as "any portion of chromosomal material which potentially lasts for enough generations to serve as a unit of natural selection".[981] A gene is defined by its immortality or lastingness, and not by its physical properties (cf. ➲ p. 255 f.). But given such a general notion of a gene, it then means almost nothing to claim that the gene is the sole unit of (replicator) selection. The question 'what is the entity which lasts through generations and could count as replicator?', is answered with 'the entity (defined as 'gene') which lasts through generations and could count as replicator'. This is evidently true – but only because the answer tautologically repeats the question. The formulation only tacitly introduces a second criterion for being a unit of selection. Besides being a replicator now also longevity is required, which refers back to the concept of substance. However, we currently simply accept this criterion as adequate as well. In regard of a tautological formulation of gene-atomism, an early critic of the selfish-gene view of evolution pointed out that this is like "someone analysing language, who insists that we must find its fundamental elements, but talks as if it did not matter whether we take those elements to be letters, words or sentences."[982] And indeed sometimes it appears as if Dawkins himself intended to define genes completely tautologically, allowing much larger units than *single* genes.[983] "What I have now done is to define the gene in such a way that I cannot help being right!"[984]

But there are several reasons which speak against the view that Dawkins and other gene-Darwinians use the term 'gene' merely to speak about any replicator, however complex. Firstly, gene-atomism would have stated nothing new, apart from that there are units of selection. It would still not be clear, if a small bit of DNA, a genotype, a whole gene pool, or a whole hierarchy of levels should be regarded as replicator. In spite of obvious tautological aspects of the above definition, Dawkins and other proponents of gene-atomism, of course, have not chosen the word 'gene' by chance and could scarcely have used 'system of genes', 'genome' or 'gene-pool' instead. As indicated earlier, a title like 'The Selfish Genome' or 'The Selfish Gene-Pool' would have implied a totally different research programme.[985] Additionally in some definitions of genes smallness is mentioned: a gene is "a genetic unit that is small enough to last for a large number of generations and to be distributed around in the form of many copies"[986]. Although still advocating a fading-out definition of genes, Dawkins, in regard to sexually reproducing organisms (like humans), has always

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[980] G. C. Williams, *Adaptation and Natural Selection* (1966), p. 25.

[981] R. Dawkins, *The Selfish Gene* (1976/1989), p. 28.

[982] M. Midgley, *Gene-Juggling* (1979), pp. 450-451.

[983] R. Dawkins, *Replicator Selection* (1978), pp. 68-69; *In Defence of Selfish Genes* (1981), pp. 568-570; *The Extended Phenotype* (1982/1989), pp. 85-87, 89.

[984] *Idem*, *The Selfish Gene* (1976/1989), p. 33.

[985] Cf. e.g., R. Dawkins, *In Defence of Selfish Genes* (1981), p. 559; *The Selfish Gene* (1976/1989), p. 33.

[986] *Idem*, *The Selfish Gene* (1976/1989), p. 32.

argued that because of the meiotic shuffle, "small fragments of genome" are the only biological candidates for a replicator.[987] "The shorter the genetic unit is, the longer – in generations – it is likely to live" and to count as a replicator. He has also called his view 'atomistic'.[988] Moreover, Dawkins himself regards 'higher' forms of selection and the concept of a hierarchy of replicators as utterly wrong[989].

Hence, I think we are entitled, to conclude that gene-Darwinism, as advocated by Dawkins, despite tautological aspects in the definition of genes, has actually favoured a concept of selection exclusively on the level of small genetic fragments. Apart from exceptions like non-sexually reproducing plants, the term 'gene' according to this paradigm exclusively refers to small piece of DNA.

(2) But, if according to this strict gene-atomism *small* piece of DNA are the *only* units of (replicator) selection, I think this paradigm has to be rejected. Reasons for a rejection of this approach are worked out in the next three sections.

> This should, of course, not imply that I want to damn single genes in general as one level of explanation. I do appreciate that sociobiology has introduced this level.[990] Still, I shall argue that gene-atomists have gone much to far in claiming that single genes are the only units of evolution and to understand them as being totally independent and radically selfish. In contrast to gene-atomism I shall advocate a multi-level approach in which single genes also have their place, and in which the acceptance of higher levels reduces, though not necessarily completely eliminates, the selfishness on the level of genes.

b) Higher Genetic Units – Despite the Meiotic Shuffle

(i) The General Possibility of Emergent Higher Genic Units

The denial of larger units of present gene-Darwinism refers back to Fisher, often quoted by Dawkins.[➲564] Alternatively, authors of the second step of the evolutionary synthesis have tried to reduce the atomism of 'bean-bag genetics' (Mayr) in their work, and stressed the contextuality and interaction of genes (➲ pp. 127 f.). Some of these authors even explicitly advocated a general position stressing emergent properties on the level of systems.[991]

Although gene-Darwinism brought back gene-atomism, there are also theoretical germs within this paradigm itself, which, I think, point beyond atomism. I have worked out that the central concept of a replicator refers to information rather than to matter (➲ pp. 255 f.). In my opinion it is a general tendency in sociobiology to emphasise the information-transferring property of genes, which not only make copies of themselves, but support copies of themselves in other organisms. This also becomes apparent in the (helpful) metaphors of DNA as 'a text', the four amino acids

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[987] *Ibid*, pp. 29 f., even his, in this regard, more guarded R. Dawkins, *Replicator Selection and the Extended Phenotype* (1978), p. 62, even p. 68.

[988] *Idem*, *The Selfish Gene* (1976/1989), p. 29; *The Extended Phenotype* (1982/1989), p. 113.

[989] E.g., R. Dawkins, *The Selfish Gene* (1976/1989), pp. 2, 39; *Replicator Selection and the Extended Phenotype* (1978), p. 62.

[990] E.g., R. Dawkins, *Replicator Selection and the Extended Phenotype* (1978), p. 66.

[991] E. Mayr, *The Growth of Biological Thought* (1982), pp. 63 f. (➲ pp. 130, 134).

as ‘the alphabet’[992], or the ‘river of DNA’ as a “river of information, not a river of bones and tissues”[993]. Taken to its own logical conclusion, it would become clear that genes understood as information could not be interpreted without their context.

> Philosophers might be reminded of the debate about basic sense data, where philosophers from different schools of thought like Gadamer, Quine and Rorty criticised the concept of elementary units of interpretation.

Likewise genetics, as it appears to me, increasingly understands the genome not by the analogy of atoms or beans, but rather by the analogy of a computer program. The genome becomes characterised by contextuality and structuredness. This becomes apparent if one considers concepts like codogenes, exons, introns, regulatory genes, reparation mechanisms, mobile genetic elements etc.

Even without explicitly referring to information it becomes apparent that genes could not be understood without considering their phenotypic effects and its genotypic context. If one thinks, for example, of a ‘monogenic’ inheritance for blue eyes. Even in this very simple case, where only one homozygous allele is said to have a phenotypic effect, selection of that single allele can only take place in a certain genic context. In the case of albinism a missing enzyme (tyrosinase) and the resulting lack of the pigment melanin leads to colourless eyes, which appear pink because the blood vessels of the retina are visible. This may be the case although alleles ‘for blue eyes’ are still at its locus, but because of the missing enzyme they are actually not ‘expressed’.[994] In this sense there is even in the case of monogenic inheritance no real independence of genes, there is, strictly speaking, no ‘monogenic’ inheritance. In order to provide the colour of something, that something has to be in place. The gene ‘blue (eyes)’ can only develop and survive together with the totality of genes required ‘for the character of eyes’. Hence, could we to a certain extent regard this unit as a higher-level gene and itself as a unit of selection?

Particularly, within a Darwinian paradigm, it appears possible to say that where the new unit has a different inclusive fitness from its separate parts, the unit, will – by definition – have an effect on the selection process. Hence this higher-level gene fulfils the criteria of being a unit of selection.[995] It is a chunk of DNA, which carries genetic information, which is longer than a single gene (in Dawkins sense); it replicates and has an evolutionary impact.

In the case of asexual organisms, where no crossing-over takes place, any higher-level gene, which improves the inclusive fitness of the organism as a whole, directly fulfils the criteria, of potentially being immortal or at least long-lived (which we

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[992] E.g., R. Dawkins, *The Selfish Gene* (1976/1989), p. 23; *The River out of Eden* (1995), pp. 11 f, 41, 43.

[993] *Idem*, *The River out of Eden* (1995), p. 4, also p. 19.

[994] R. Dawkins seems to accept such facts, but presumably due to his germline-reductionism and to his argument concerning the meiotic shuffle he draws opposed conclusions, *In Defence of Selfish Genes* (1981), pp. 565-568.

[995] For quite small units this is accepted also by R. Dawkins, *The Selfish Gene* (1976/1989), p. 32, also ➲ footnote 983, 985, 986.

currently simply accept). In case of sexual organisms, we additionally have to face the problem of the meiotic shuffle.

(ii) Higher Genic Units Despite the Meiotic Shuffle

Sexually reproducing organisms have always been of foremost interest, since we ourselves belong to this group. The evolutionary synthesis particularly focused on them, because its theoretical core of population genetics is concerned with sexually reproducing interbreeding organisms. Gene-Darwinism, although in many respect at odds with the synthesis, also focuses on this class, since only there this "central argument"[996] of meiotic shuffle supporting gene atomism comes into play. In the genetic shuffling during meiosis (the special kind of cell division to produce sex cells), the "genome is shredded to smithereens" and gene-Darwinians, like Dawkins, conclude from this fact that only *short bits* of DNA can be regarded as continuous units of selection.[997] As outlined earlier, gene-Darwinians thus argue that the "shorter a genetic unit is, the longer – in generations – it is likely to live"[998]. Even if a gene-atomist would concede that a gene can not be interpreted without its context, he or she, based on the fact of meiotic recombination, would still conclude that it is not this context which is preserved, and hence there are no higher-level replicators.[999]

There are two possibilities for challenging this view. Either replicators have not to be lasting to qualify as units of evolution or larger units are actually in some sense lasting as well. I focus on the latter aspect and advocate that larger units in a probabilistic sense are actually lasting, but thereby I also challenge the assumption that units need to be lasting in the (materialistic) sense of permanent presence in each concerned instance.Gene-atomists argue that as a gene travels from genome to genome through the generations, the genic context changes completely. This, in my opinion, is wrong. Gene-atomists, although in other respects having started to understand genes as information, here in a somewhat old-fashioned way remain materialistic. This is linked to the – already old – 'modern' materialist understanding of substance. According to gene-atomists, permanence is only given if a nexus of 100%, in the sense of a material continuous unity of one body, is given (which excludes systematic synergetic properties).

But despite the meiotic shuffle, obviously some contextual continuities do still exist. The Hardy-Weinberg equilibrium, which is concerned with alleles, is based on this fact. In regard of different loci, the very notion of a locus already assumes a certain structure and a given context. A chunk of DNA 'determining the eye colour of humans' on its own, put into a test-tube with nutrients, will, of course, never develop the blueness without an eye, or an eye without a body. Also in regard of loci

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[996] *Idem*, *The Selfish Gene* (1976/1989), p. 29.

[997] *Ibid,* pp. 25 f.; *Idem, Replicator Selection and the Extended Phenotype* (1978), p. 68 (quote).
As mentioned earlier, Dawkins in the latter publication is in this respect much more guarded, than in his *Selfish Gene.*

[998] *Idem, The Selfish Gene* (1976/1989), pp. 25, 29.

[999] R. Dawkins, for example, replies to E. Mayr's stress on the context of a gene in this way, *Replicator Selection and the Extended Phenotype* (1978), p. 69.

continuities result from frequency distributions of gene-pools, and not only from the direct descent of organisms[1000]. Not only in asexual organisms but in sexually reproducing organisms too, the gene for eyes being blue will of course usually find itself united with genes for the general existence of the eye. Standard contexts could even be regarded to be a precondition for speaking of certain genes at all.[1001] If this is provided, I see no reason to deny in principle the possibility of higher-level genes in gene pools, only because they do not assemble in each and every generation.

An entity based on probability distributions does not need to appear remarkable, the more so, if we think of modern physics. Playing a causal role and being potentially long-lived, it should in principle (despite further qualifications) be possible for such higher units to count as a unit of evolution.

One is even inclined to argue that the longer the genetic unit is, the more it is on average interpretable in terms of phenotypes and the larger is its evolutionary role. The wholes only exist in a probabilistic sense of context, where the whole does not only determine the parts, but the parts in their particular combination and inner dynamics also determine the whole. Hence, the envisioned non-reductive holism, which does not deny the relevance of parts and which is based on a probabilistic or field understanding of wholes, need not be linked to that sort of Platonic (opposed to an Aristotelian) essentialism, which neglects varieties and which has been criticised by Popper, Hull and Mayr.[1002]

> It lies outside the scope of this work to clarify the relation of this field interpretation to my field theory of exformation (➲ pp. 324 f.).

To sum up, if there is a sufficiently high probability of coming together and togetherness causing a property which causes an increase in the fitness of this system compared with each of its parts, then – leaving all other things equal – the union will itself have the tendency to survive. Despite the meiotic shuffle higher-level genes can probabilistically have an evolutionary relevance.

> Matters, as we will see, are more complicated, since the tendencies of the parts have also to be considered. Only under certain causal conditions the effects of a whole lead to stabilise the system.

[1000] The term 'gene pool' still has the misleading connotation of being totally structureless, which is usually not the case.

[1001] K. Sterelny, P. Kitcher, *The Return of the Gene* (1988/1998), p. 163. In that paper it is argued that the stability of the context is given, in order to defend the gene-Darwinian tenet that single genes do exist. The authors objected to St. J. Gould's argumentation in *Caring Groups and Selfish Genes* (in *The Panda's Thumb,* 1980, p. 77). Although in my view Gould was right in stressing the context dependence of genes, I agree that the not direct visibility of genes, does not entail that they do not exist. I do not deny the existence of single genes, but I criticise the claim of their exclusive existence. An acceptance of a stable context, using Sterelny's and Kitcher's argument with a different intention, also allows for higher-level units and thereby undermines gene-Darwinian atomism.

[1002] Cf. also: M. Ruse, *David Hull Trough Two Decades* (1989). G. Webster, B. C. Goodwin, *Form and Transformation* (1996), pp. 9, 17 f., 99-100. (On the Plato's and Aristotle's understanding of forms, ➲ also pp. 71 f.).

Synergetic or systemic properties, which I have tried to justify probabilistically, are often discussed under the keyword of the *additivity criterion*.

The additivity criterion of a unit of selection was first in detail made explicit by W. Wimsatt and then, in a different way, was elaborated by E. Lloyd.[1003] I abstract from their views and state a – I think – similar formulation in my own words. Perhaps this definition rather mirrors Wimsatt's position: A unit of selection is any heritable entity or type of entity, which has an additional fitness (and in this regard varies to entities which have not this property), which does not appear at any lower level of organisation.

> This is not much more than the general old idea that 'the whole is more than the sum of its parts', applied in a Darwinian context. This simplified – and thereby maybe trivial – idea is implicitly present in many earlier evolutionary texts, for example in those of Gould and Lewontin. Also my argument above of the possibility of synergetic higher genic units in principle repeats these ideas, although applied on the side of the replicator, and not on the side of interactors.
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> The actual definitions of Wimsatt and Lloyd are actually more refined, one focusing on context independence, the other on strict additivity. But for my purposes the further details appear not to be relevant. My proposed definition is perhaps even in contradiction with some aspects of Lloyd's definition[1004].

Given a Darwinian framework, additivity or synergetic properties with a fitness effectseem to me to be necessary conditions for the evolutionary existence of wholes and thus for the transcendence of gene-atomism.[1005]

Elliot Sober and David Sloan Wilson opposed the additivity criterion, although they criticised the philosophy of egoistic genes in a different way.[1006] I do not discuss whether Sober and Wilson are right in respect of any specific formulation of the additivity criterion.[1007] I think that they did not turn against the above more moderate exposure of synergetic properties (or if they did, they were wrong in doing so):

> Sober and Wilson in regard of a specific formulation of the additivity criterion argued, that groups which properties which are in a linear way dependent on the proportion of altruist members would by this definition be excluded from counting as wholes. But this assumption is central for their group selectionist models, and I agree that it would be absurd to exclude such groups from being a counterexample to gene-Darwinism. But, I think, a well understood concept of synergetic properties does not exclude these wholes. Such a linear relationship does not entail that the resulting entity is merely the sum of its parts. Instead the wholes or groups in Sober's and Wilson's examples show supersummative properties, which depend in their amount on the proportion of certain members. Hence, in my understanding, this could be counted as an example of a synergetic property. Thus, I tend to follow Lloyd,

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[1003] E. Lloyd, *The Structure and Confirmation of Evolutionary Theory* (1988/1994), pp. 69 f. W. Wimsatt, *Reductionistic Research Strategies and their Basis in the Units of Selection Controversy* (1980), p. 236.

[1004] E. Lloyd, *The Structure and Confirmation of Evolutionary Theory* (1988/1994), p. 102.

[1005] In a not purly Darwinian framework, it may be questioned, whether evolutionary morphological constrains, which also may have an impact on the direction of evolution, are adequately treated in terms of fitness.

[1006] E. Sober, D. S. Wilson, *Philosophical Work on the Unit of Selection Problem* (1994/1998), pp. 203 f.

[1007] E.g., E. Lloyd opposed this view, *The Structure and Confirmation of Evolutionary Theory* (1988/1994), pp. 72 f.

> who had pointed out that Sober implicitly employs the additivity criterion.[1008] At least provided a general understanding of synergetic properties this appears to be valid. Otherwise Sober and Wilson would not have been able to propose group selectionist models, based on the additional fitness of the whole group, differing from the fitness of its elements.

In any case, I think that Sober and Wilson were right in having pointed out that a causal approach is also needed,[1009] to show why a structural property of the super-summative whole (for example due to the altruism of its members) is not overrun by selfish members.[1010]

Therefore further scrutiny of this topic is needed. The next sections will be concerned with several questions regarding how far wholes can have a causal impact on their parts and in how far wholes are not undermined by selfish tendencies of their parts. Additionally, the question is considered once more whether it would be more appropriate to convert the parlance of higher-level units into single gene-parlance. Finally, we will be concerned with the question in how far the results for loci in one individual are valid for alleles in different organisms as well.

c) Top-Down Causation and Higher-Level Genes at Different Loci

In this section we will firstly be concerned with the general relationship of higher-level properties to downward causation. Secondly, the question is treated, whether higher-level genes (a system of genes, which only together have synergetic properties for the good of the system), are probabilistically stable enough not to be overrun on a lower level by alleles which do not have this property.

(i) The Relationship of Higher-Level Genes and Downward Causation

Above I have advocated the probabilistic existence of synergetic properties of alleles at different loci, despite the meiotic shuffle. Now we additionally assume the stability of these probabilistic high-level genes, in the sense of not being undermined by selfish components (this will be discussed below). We discuss whether high-level genes under these conditions imply what has been called 'downward causation'[1011].

Properties of systems of genes in a way have to be causally relevant, otherwise we would not perceive them and would not speak of a property being there at all. But here we are not interested in some causal relevance, but specifically in an evolutionary relevance. In a selectionist model, from which we started our discussion, all properties which bear on the fitness are by definition (in average) evolutionarily relevant and, hence, synergetic properties which have such an effect (higher-level genes) are also evolutionarily relevant (we may think of the example of eyes as wholes).

Does this entail downward-causation, a top-down causation, which I use in the sense that wholes may be causally relevant for their parts?

[1008] Cf.: *Ibid*, pp. 82, 85.

[1009] Cf.: *Ibid*, pp. 82 f.

[1010] E.g., E. Sober, *What is Evolutionary Altruism?* (1988/1998), p. 462.

[1011] A term, I think, first proposed by D. T. Campbell.

In principle it is not obvious that wholes could have an impact on parts. According to a generally downward reductive, materialistic ontology, which advocates a modern understanding of substances, wholes do not exist at all or are at best regarded to be epiphenomena. Wholes in this view are merely effects of the composing parts. It is, of course, true that a whole can by definition not exist without its parts (at least not in an actual sense), but this does not imply that the whole is nothing but its parts. A whole is not something alien to its parts, but it is its parts *and* specific relations between them. Based on my earlier critique of the modern downward reductive understanding of substances in general, I treat properties of systems, as long as they are not shown by their parts on their own (or at least in most other combinations) as properties of these systems, of larger wholes. I do not deny the existence of atoms, but I regard molecules with their specific relationships of parts to be real as well, having specific new properties which their elements do not have on their own (➲ p. 245).

In a selectionist context, properties of a system, which change the fitness of that system, by definition not only influence the survival of the system, but thereby also influence its parts. Hence, parts may become selected, because of the properties of higher genic wholes (properties of systems of genes). Depending on the importance of such higher-level properties, alternative compounding alleles may perish, although, taken separately, they might have a higher fitness. Hence, higher-level genes can in principle have an evolutionary effect on the composing genes. Any such top-down effect, if actually found, is in contradiction to the spirit of the arguments and polemics of gene-Darwinians that single genes are maximally egoistic and can never serve any higher wholes.

It is scarcely conceivable that properties of a high-level gene (here at several loci) have no effect on the composing alleles. The only case in which this may be conceivable is that of a restructuring of the genome without changing which genes are necessary. If different high level genes are based on the same underlying alleles, a more advantageous system may become established, without affecting which alleles build these systems. Here an evolutionary pathway may be taken which is best for the larger unit, with no effect for its elements. For example, if the genome of an organism by a specific type of mutation like an inversion or a translocation became restructured and this organism founded an isolated new population (founder effect), an improved high level-gene may evolve by changing the relations of the loci, without changing what composing alleles are advantageous. It might, for instance, be advantageous if the loci of a high-level gene are on one chromosome.

Actually the species *drosophila melanogaster, d. subobscura, d. pseudoobscura* and *d. willistoni* differ mainly in their chromosomal structure.

If this population and the other population remained functionally isolated, the new founded population only differing in respect of its advantageous high-level gene – and not in respect of its genetic components – would probably outbreed the other. In this sense, here no direct top-down effect is given. Nevertheless the increased fitness of the whole may indirectly still change the fitness of its parts.

In conclusion, the existence of fitness changing properties of a system of genes (higher-level genes) are not only a *necessary* but a *sufficient* condition for top-down causation, at least as long as we are not only concerned with a restructuring of the genome.

(ii) The Stability of Higher-Level Genes on Different Loci

Probabilistic higher-level genes, can be stable in the sense of not being overrun by alternative 'egoistic' genes on the lower level.

In the present section we will be concerned with genes at different loci and we only later turn to the more difficult problem of alleles in different organisms (although this will play a role here as well). The question of higher-level genes at different loci has long been ignored, since the evolutionary syntheses was concerned with allelic competition and, at least in its early phase, which Mayr called 'bean bag genetics', the assumption of the independence of genes has often been taken for granted. Although the synthesis later increasingly acknowledged the dependence of different loci and alleles, the synthesis remained to be based on models of population genetics, where loci have been treated as somehow given, whereas the alleles were seen to be objects of competition and evolution. Proponents of the second phase of the synthesis, like Mayr, were also not required to defend higher-level genes, because they claimed that the individual phenotype, not the gene, is the unit of selection, and the species, not the gene, is the unit of evolution.

A defence of higher-level genes only becomes necessary against the background of the gene-Darwinian claim that any selection is ultimately gene-selection and that all evolutionary entities are reducible to single genes (➲ pp. 140 f.). In principle the unity of the organism remains mysterious to gene-Darwinians.[1012] "Fundamentally, all that we have a right to expect from our theory is a battleground of replicators, jostling, jockeying, fighting for a future in the genetic hereafter."[1013] Hence it was only consistent that gene-Darwinians have broken the dike between genes at different loci and genes on the same locus (alleles), though, of course, not denying their differences. Gene-Darwinians have shown that genes on different loci in one genome are competing.[1014] Moreover, it became obvious in section *a*, that gene-Darwinians have argued that in respect of sexual organisms only short strands of DNA could count as evolutionary units.

It should now be shown that higher-level genes at different loci, whose existence I advocated earlier, can under certain conditions be evolutionarily stable and are not undermined by single alleles which do not show the synergetic properties of the system.

In order to show this, we take a closer look at the concept of a genetic system of genes A, B at two loci, the simplest possible genic system. For our purposes their distance on the chromosome or whether they are located on different chromosomes should not be taken into account. Although this distance is one factor determining the probability of the genes appearing together in directly successive generations. Here we

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[1012] Cf. e.g., R. Dawkins, *The Extended Phenotype* (1982/1989), p. 5.

[1013] R. Dawkins, *The Selfish Gene* (1989), p. 256.

[1014] *Idem*, *The Extended Phenotype* (1982/1989), pp. 156 ff.

are concerned with higher-level genes, whose probability of being united in the same genome, despite the meiotic shuffle, is a probability function of the frequency of both genes in the population. We assume that only in union do these two genes have a certain synergetic property improving the fitness of the two locus system:

$$F(A, B) > F(A, b_j),\quad F(A, B) > F(a_i, B),\quad F(A, B) > F(a_i, b_j)$$

Here a_i and b_j are the classes of alternative alleles corresponding to A and B (for our present example it does not matter how many alternative alleles there are). Focusing on this one higher-level effect, we stipulate for reasons of simplicity, that there are no such synergetic effects in the case of other combinations of alleles and that all these other combinations have the same, lower, fitness value:

$$F(a_i, b_j) = F(A, b_j) = F(a_{i,}, B).$$

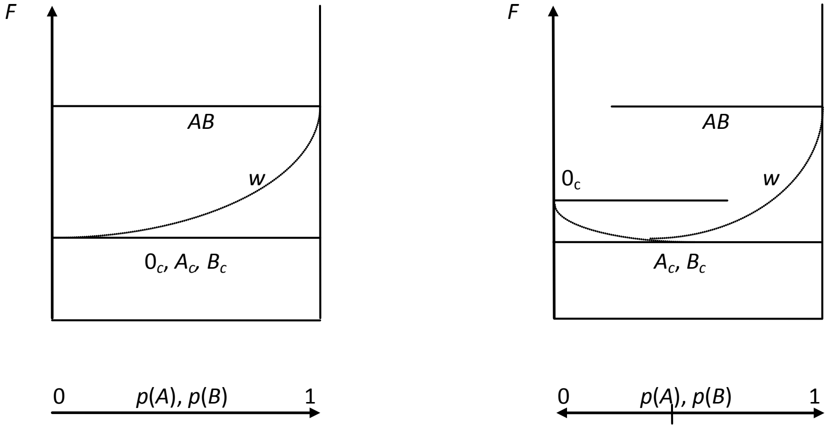

Figure 3 and 4: The high-level gene *AB* could be fitter (*F*) than their components *A* and *B*. The right figure shows that even if their components are less fit outside of this system compared with each of their alternative alleles, the systemic advantage may still make them evolutionarily stable, if these genes are probable (*p*(*A*), *p*(*B*)) enough so that the synergetic effect counterbalances this undermining effect. In this case, the resulting fitness average fittness of the allele *A* (or *B*), indicated by *w*, has two optima, resulting in two evolutionary stable frequency distributions (indicated by the arrows).

In Figure 3 the fitness values of these gene combinations are depicted as being dependent on the frequency of *A* and *B* relative to their alternative alleles in a given population. In order to present such a two locus model in one graph, which is normally used for presenting the relative frequency of two alternative alleles at only one locus[1015], we have to make some simplifying assumptions. We stipulate, only for reasons of representation, that the probabilities *p* of *A* and *B*, and of their alternative alleles should be coupled: $p(A) = p(B); p(\neg A) = p(\neg B)$. This is irrelevant for my argument, but makes it possible to depict the relative frequencies of alleles of both loci on one axis.

> We also assume that synergetic effects have an absolute, not a relative, advantage in the population. Therefore all fitness values for certain combinations of genes are parallel to the *abcissa.*[1016]
>
> Furthermore we, of course, employ the usual assumption of population genetics that the gene pool is unstructured and that all genes mix randomly. These assumptions will be criticised later, but for the time being they are helpful.

In the chart the gene-combinations of *A* with *B* is called briefly ‘*AB*’. The other combinations, of *A* with some b_j, of *B* with some a_i, and of some a_i with some b_j, are called ‘A_c,’ ‘B_c’ and ‘0_c’.

Let us first look at Figure 3 (left figure). If the probabilities of *A* and *B* are low, there will only seldom be an *AB* combination and its synergetic advantage will almost never come into play. Hence also the average fitness of *A* (or *B*) in this population (*w*) stays almost as low as if the synergetic property did not exist at all. In this first model *A* and *B* on their own (combined with some different alleles on the other locus) are neutral, if compared to their alternative alleles. Hence, if *A* or *B* evolved by mutation they will not directly be counter-selected. Instead one day the combination of *As* and *Bs* will come together to form a high level gene and then have a higher probability to multiply. The more *As* and *Bs* are present in the gene pool the more often the *AB*-system will have an advantage, until finally all a_i and b_j alleles become extinct. Although the fitness of *A* and *B* gave each of them, on their own, no advantage, their systemic two locus interaction leads them to gain dominance in the population. Already in this case, I think, it would be inappropriate to reinterpret this in terms of gene-atomism or gene-egoism (➲ below and section e and f).

In Figure 4 my point becomes easily apparent. I am only changing one assumption. Now we stipulate that the *A*s and *B*s, as long as they are not building their system, are less fit than their alternative alleles a_i and b_j.

$$F\,(A, B) > F\,(a_i, b_j) > F\,(A, b_j) = F\,(a_i, B)$$

A single *A* or *B* mutant will now be counter-selected and will soon die out. Here the genes which together (systemically) are advantageous for the larger system, will not survive. Only if *A* and *B* (as by a founder effect) both have a high enough relative frequency that the advantages of the *AB*-system often enough came into play and could counterbalance the other effects, would the *AB*-system soon come to dominate the population. With other words, the *AB*-system, under these conditions, is an

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[1015] Cf.: E. Sober, *What is Evolutionary Altruism?* (1988/1998), p. 463. E. Sober, D. S. Wilson, *Philosophical Work on the Unit of Selection Problem* (1994/1998), p. 207.

[1016] In a different context: E. Sober, *What is Evolutionary Altruism?* (1988/1998), p. 463.

evolutionarily stable strategy. A mutant a_i, or b_j gene, which under different conditions would have had a higher fitness than A and B on their own, would now have a lower fitness value.

One should note, that besides the synergetic property of A and B, we are here also concerned with the phenomenon of the changing of fitness values dependent on the frequency of composing genes in the population. In my view, this, based on the existence of higher-level genes, is another synergetic property of the relative frequency of genes in a given population.

Back to our starting question, higher-level genes which have a positive effect on a system at large, could under certain conditions be evolutionarily stable, even if each of their composing genes, taken on its own, is less fit than their alternative alleles. This corresponds to the intuition that without higher-level genes, which are based on elementary genes and are good for a larger whole, despite being less fit outside this specific allelic context, the actual quite harmonious whole of the individual genome would be inconceivable.

I have to concede that up until this point we have not much concerned ourselves with the question of the possibility of altruism *between* organisms, since we have treated higher-level genes at two loci of one genome (although also the synergetic property of a population became apparent). Later, we will discuss to which extend these arguments can be generalised. In any case this argument, possibly trivial from the viewpoint of other Darwinian paradigms, clearly undermines the gene-Darwinian philosophy that (in sexual organisms) only single genes are the units of selection and all higher levels are epiphenomenal.

But we have not yet reached secure ground, because gene-Darwinians may still object that the above phenomenon could be better expressed in gene-Darwinian terms. I shall argue that such a claim is at odds with our common understanding of a system. If based on systemic properties, those genes become selected which establish the system and, although they are disadvantageous on their own, it would be absurd to claim that the system does not exist, but rather only single selfish genes. But this needs to be scrutinised more closely. In the next section I argue that strict gene-atomism has to be either refuted or one has to define the gene as a unit of selection tautologically.

d) The Fallacy of Claiming Gene-Atomism Tautologically

Dawkins in the *Extended Phenotype* proposed that different evolutionary perspectives may be like two different views of a Necker Cube, a visual illusion, where a two dimensional representation of a cube could be interpreted in two completely different ways as a three-dimensional cube.[1017] Dawkins, with his own gift of creating illuminating metaphors, captures an experience of the flipping over of evolutionary perspectives apparent to anyone, who has seriously pondered these matters. Dawkins

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[1017] R. Dawkins, *The Extended Phenotype* (1982/1989), pp. 1 f. Cf. the preface of the second edition of R. Dawkins, *The Selfish Gene* (1989), p. iix.

compared the gene-perspective with that of a whole individual, but I think one can do this equally well when one compares the single gene perspective with the group perspective or that of higher-level genes, as done in the last section.

Should we hence simply draw the pluralistic conclusion that all these perspectives are true? This appears absurd, because these perspectives appear at least partly to be inconsistent, particularly in their philosophical message. Gene-Darwinism, but equally my opposed position above, would become *a priori* irrefutable.

Of course, gene-Darwinians do not actually advocate such a pluralism, but, as I have shown earlier, they do strictly take sides. They finally advocate an exclusively gene-atomistic perspective. Dawkins even in the *Extended Phenotype*, albeit more guarded on this matter than in the *Selfish Gene*, clearly takes the view of gene-atomism (➲ pp. 140 f., 264 f.).

Above I have opposed the idea of an undecided pluralism on this matter as well. I oppose strict gene-atomism, although I think that even gene-atomism has a true core. Unlike some authors who have denied them, I accept that single genes could have evolutionary effects. Nevertheless I object to gene-atomistic denial of all larger wholes. In terms of the atom metaphor, I try not to discard genetic 'atoms' (although they are even more context-dependent than atoms proper are), but argue in favour of the existence of genetic 'molecules', of high level genes, in their own right. I do this particularly in a selectionist context (but I also literary have argued for the existence of molecules in their own right, ➲ pp. 248 f.).[1018] To argue that parts *and* wholes could play an evolutionary role and that the task is to determine in each case how far wholes are important, differs not only from the view that parts are exclusively the units of evolution, but also from a pluralism, which regards this to be a mere question of perspective.

Now the question needs to be settled whether it is always possible to convert higher-level explanations, as for example mine above, into a gene-atomistic language and, if this is the case, whether this is an appropriate and preferable representation of given facts.

It is obvious that in a certain sense one can transform the proposed concept of higher-level genes (as, I shall argue, of all other higher wholes) into the language of single separate genes, since biological replicators, whether whole gene-pools or genomes in some way consist of single genes. A whole always consists of its parts. Hence, one may always somehow distribute the effect of the whole to its parts, and thereby make the whole disappear. Even if the whole is more than the sum of its parts, one can still proceed in a similar way. In this case it is not possible to directly distribute the effects to its parts, because the parts lose these properties if they are not part of the system. But indirectly it is still possible to distribute these properties, if one introduces the additional condition that this 'distribution' is valid for each of the involved elements only if they are together and standing in a certain relation with these other elements which before were said to form a system. Besides, the sense of

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[1018] I am aware that even molecules are, of course, a poor analogy for systems of genes. Cf.: St. J. Gould, *Caring Groups and Selfish Genes* (in *The Panda Thumb,* 1980), p. 78.

distributing the effects has changed. In my example of high-level genes the process of distributing could, of course, not mean dividing the fitness by two and adding these halves to *A's* and *B's* fitness. Instead, the synergetic fitness of the system *AB* would be 'distributed' in a way that *A,* under the condition of the presence of *B*, would have a *completely* changed fitness value; and, vice versa, *B* as well. Hence, with these two additional modifications, we can always rephrase the phenomenon of higher-level genes in terms of single genes. The question is whether this is reasonable and if this implies that single selfish genes could justly be called the only units of selection.

In my opinion a redefinition for which the mentioned additional assumptions have to be made does harm to what we usually call a system. These assumptions of our definition only conceal any system, which by any reasonable definition would be said to exist. With that definition one would also be able to redefine the result of the most radical group selectionist approach, against which gene-Darwinians always have turned, in terms of single genes only. It shall be made apparent in the course of this section that this is not an aspect of the gene-Darwinian claim which is scientifically respectable, but a vacuous argument; however organised a system may be, it can only be described in terms of its composing parts. This does not contribute anything to the discussion concerned. To clarify this matter we must once more take a look at gene-atomism.

In my view two different gene-atomistic claims, which are often found in gene-Darwinism, need to be distinguished. The first claim is at least somehow empirically based and indirectly testable, the second claim, however, is, as I shall show, tautological. Rather like Sober and Wilson, I think that officially gene-Darwinians normally only made the testable claim, but that in the argumentative twilight of many discussions the tautological idea has contributed much to the appeal of this paradigm.[1019] If one wants to oppose gene-atomism one needs to disentangle the testable and the tautological arguments which somehow support this paradigm.

(i) The Testable Claim of Gene-Atomism

During recent decades, many concepts and many phenomena have necessitated the use of an explanatory level of single egoistic genes. I think this has become sufficiently apparent in the several treatments of gene-Darwinism represented in this present work. Although I do not agree that all concepts and phenomena employed by apparent gene-Darwinians are purely gene-Darwinian, I, in any case, basically agree, for example, with Sterelny and Kitcher as far as they argue, that it was indeed reasonable, empirically justified, and likewise a fruitful research programme, that lies behind gene-Darwinians stress on the existence of single genes, below the level of the whole genome and below whole gene pools.[1020] This, in my opinion does not, of course, entail that there are no higher levels of explanation existent as well.

Gene-Darwinians, as we have seen earlier, do make a stronger claim. To them, selfish genes are the *exclusive* units of selection, excluding all higher levels.

[1019] E. Sober, D. S. Wilson, *Onto Others* (1998), pp. 33-34.

[1020] K. Sterelny, P. Kitcher, *The Return of the Gene* (1988/1998), pp. 161 f., 167 f.

This idea has been supported by the success of explaining some important cases of traditional group selection by the new concepts of kin selection and reciprocal altruism (➲ p. 36). Gene-Darwinians have interpreted these theories as supporting their exclusive gene-atomism. Although it appears correct to me that single genes do play a role in these explanations, they, even in these examples, do not play an exclusive role. I have called into question whether reciprocal altruism is exclusively a single gene phenomenon, since the condition under which this evolutionary mechanism itself becomes an evolutionarily stable strategy, and is not undermined by cheaters, is also dependent on gene frequencies of populations, which are properties of the population and not of single genes. More strikingly, group phenomena of the hymenoptera – traditional examples of group selection – have been reinterpreted. Genetic relationship and not group selection, appears to be pivotal. Nevertheless the entomologist and co-founder of sociobiology E. O. Wilson himself still seems to have interpreted these explanations in a less radical gene-atomistic way than, for example, Dawkins.➲ [58] We see that even these matters are entangled with interpretation. The involved theoretical changes were, it seems, in any case no mere redefinition of terms. Since its interpretation is problematic, however, we turn to a less ambiguous example.

It was most crucial for the radical formulation of radical gene-atomism, that theoretical considerations and supporting empirical evidence, had, seemingly, shown that the remaining pure group selectionist models were flawed. Although theory here almost also seems more important than the facts (as I think it should be), these group selectionist models were not challenged by a mere redefinition of terms. Instead it was argued that groups were true altruism of genes and individuals is possible because group selection, could easily be undermined by selfish genes. In this argument the group advantage is not simply defined away and distributed among the individual members, but a causal problem is stated, relevant also for those who hold the opposed view. We are hence concerned with a testable or changeable claim.

> Later I shall actually discuss whether this problem, which some naive group selectionist models contain, can be surmounted, ➲ p. 284.

In my view, gene-Darwinism, also correctly point out that there is inner organismic genetic competition. Phenomena like meiotic drive could be interpreted in this way. I think, it was a false simplifying assumption that alleles at one locus as well as at different loci necessarily evolved, which are advantageous for the individual. As we have seen above, it may well be that a combination of favourable genes will not become fixed in a population, although this would be the most advantageous solution on a higher level of genomic organisation of an individual (Figure 4).

> Since we are concerned with a challengeable claim, it was possible to challenge it above, at least in its exaggerated version not only claiming the existence of single genes, but completely denying the existence of *all* higher units of replicator selection.

(ii) The Tautological Claim of Gene-Atomism

Firstly, the gene-atomistic tautology eliminates wholes from our semantic framework by defining wholes as being merely elements, and then makes the claim, by only restating this assumption, that it has been found that wholes do not exist. Secondly, linked to this first aspect, gene-atomists have reasoned tautologically that irrespective of the system of which a gene is part of the fittest genes always survives, only restating that fitness is defined by survival. In either case this results in an unjustified claim that genes, only because of matters of definition, are the only possible units of evolution.

> These gene-atomistic tautologies are slightly different to the found straight definition of the gene as a unit of evolution and the tautological claim that the unit of evolution hence is the gene (➲ section a).

(1) I have outlined that one can always simply redefine a whole in terms of its parts, even if the whole is more than the sum of its parts (➲ p. 278). One only has to extend the definition of each part by introducing the conditionals that the former systemic property has only been shown, if the other components of the 'system' are present as well. Even though the property can not be distributed directly to its parts, the whole property (in my example of a genetic higher-level unit) would appear under the given conditions.

If any whole, by force, is redefined to be only its elements, the non-existence of wholes is discursively *a priori* given. It is then of course true by definition that wholes can not be units of evolution. But, is it reasonable and relevant to the questions we are concerned with to proceed in this way?

I argued earlier, that the general philosophy of downward reductionism and eliminative materialism, if applied thoroughly, leads to fundamental problems and does not achieve its aims of an independent definition of explanatory elements, of explanatory parsimony, and of an explanatory basis independent of historical change (➲ p. 248). Also in the present more specific context it becomes apparent that by a redefinition of a genetic whole, the other genetic elements would need to be introduced in the definition of each single gene and that the result in this regard would not fulfil the criterion of theoretical parsimony.

More important for our present concerns is that such a redefinition would conceal the difference between a whole, or a system, and a mere aggregation. Certainly, by such a redefinition the synergetic properties would not be lost, but would only be hidden in each of the composing parts. Nevertheless, the philosophical message differs considerably if any wholes, however well integrated, are said to be only their parts. This undoubtedly would have the inclination to neglect synergetic properties. But an aggregation like sand is obviously something completely different from a system, where the sum is more than its parts. Any definition which conceals this difference is wrong in the sense of neglecting to focus on aspects which are essential to our discussion. It makes a huge difference to argue that wholes can not be evolutionarily stable because they are undermined by selfish genes, or to argue that wholes are anyway to be defined in terms of single selfish genes. Particularly in a selectionist context we want to know whether traits which are good for the whole exist and are stable.

Through my example of higher-level genes, it has been shown that combinations of genes with an advantageous systemic property and a certain frequency in the population will survive, although taken in isolation, alternative alleles are advantageous. I think it would miss the point, if one argued that in this case no systemic aspect existed. Of course, in that example, the composing genes of a whole survive too and even need to survive if that whole should be evolutionarily stable. But this does not mean that the whole is merely its parts. I do not think that it has to be a precondition of being a system, that members sacrifice themselves for it. Instead I think it is enough if genes create systemic properties (properties which the parts separately did not have), which have an evolutionary impact and which are evolutionarily stable. Also in this case genes in a way are less selfish than one may conceive, since they build up a system. In this example they do indeed profit from the system. I do think, however that it makes a difference to the case in which even such systems are undermined by genes which do not have this systemic advantageous tendency and which are more advantageous on their own.

> I concede that this is not the most radically thinkable case of sacrificing genic altruism (➲ pp. 284 f.), but nevertheless, I think, we want to make the difference between systemic genes and those which are fitter outside of a system. I will argue in the next section that ruthless genetic egoism on the one hand and radical forms of group selectionist altruism on the other hand are extreme forms of a continuum. In the above example genes, albeit not self-sacrificing, become advantageous in a certain system, although they are relatively disadvantageous on their own. Such genes differ considerably from genes, which do not build such a system. Based on systemic changes the adaptive landscape for the single genes has changed considerably. It would be unintelligible to redefine this in terms which neglected these important changes.

But even if one assumed that an altruist group evolved by group selection, which for some reason has not been undermined by selfish genes, such groups could also be redefined as outlined, since their replicators are of course somehow composed out of single genes too. This, of course, would obviously miss the issue of the unit of evolution debate.

The case of a mere restructuring of the genome, where the composing genes stay the same likewise renders the outlined redefinition absurd. If chromosomal restructuring, for example, plays a role in formation of new species, the changed species are not only reproductively isolated, but also change some of their phenotypic properties. One would normally attribute the phenotypic changes not to the single genes, since they remain identical, but to the structure of the whole. Yet one may still proceed with a redefinition, simply by including different structural relationships into the definition of each gene. Although this is formally possible, I think it is apparent that this only conceals, what we normally mean when saying that the phenotypic change is due to the structure of the whole and not to its parts.

Finally the idea of a redefinition would be inconsistent with the concession made by most gene-Darwinians, at least by actually discussing only cases of sexual organisms, that in the unimportant case of asexual organisms genomes are the units of replicator selection. In the case of a redefinition, one would absurdly have to state that here too only single selfish genes were the appropriate level of explanation.

In conclusion a mere redefinition of wholes as simply the sum of their elements is logically possible, but misses the central point of how far wholes are evolutionarily relevant and stable.

(2) A tautological formulation, which is in my opinion linked with the first one, is hidden in the argument that (in a certain sense) always the fittest single genes survive, and that it is thus appropriate to only call them units of selection.

> This has similarly been elaborated earlier by Sober and D. S. Wilson, who I generally follow here. I only differ in stressing the importance of synergetic properties, which they in my view also implicitly assume when discussing group selection instead of synergetic gene pools with fitness effects (➲ p. 271).[1021] (Additionally Sober and Wilson are only concerned with the difference of group selection and individual selection.)

If one integrates in the above ways all synergetic properties of wholes into the notion of single genes, it is of course true that the fittest genes always survive, because all systemic properties and top down effects then count in favour of single genes. This is because all assumed higher levels involved are somehow based on the genes composing them. Whatever survives, whether a certain gene-pool by group selection, a high-level gene (although its components were less fit on their own), or a truly selfish gene which does not contribute to any larger system, one may state that without any difference the fittest genes have always survived.

In particular E. Sober and D. S. Wilson have shown that, if one argues this way, even a model, where altruistic groups evolve because as a whole they are more fit than non-altruistic groups, would paradoxically still be taken as evidence for the gene-atomistic and gene-egoistic viewpoint.[1022] The group, which was fitter as a whole, is somehow composed out of individuals or single genes. Hence one may argue that it was the individuals or single genes of that group which were fitter, since they are the survivors. No matter how synergetic the genes of a group are, we can decompose them into single genes. No matter how altruistic they are redefined to be the most egoistic genes since they survived. Not taking into account whether their fitness is created by the group or the single gene, whether it is object of genic, individual or group selection etc., it is of course by definition true that those genes which survive are always the fittest genes, because fitness is ultimately defined by survive. Although true, this is, of course, completely uninformative. One would not distinguish between cases of ruthlessly selfish genes which are bad for the whole, and cases where the wholes determine what is good for the genes.

If one really were to favour such a redefinition, the more substantive gene-Darwinian argument that adaptive wholes may be subverted from within by single selfish genes, would not be necessary and meaningless, since one could in any case redefine the systemic advantage in terms of selfish genes.

> In principle a similarly absurd tautological argument in favour of levels of selection could easily be proposed. If we define a group as flexible as we defined a gene, of course the fittest group always survives. We would simply still call it a group independent of whether even its synergetic properties are subverted by selfish genes or not.

It is a tautological truth that only those genes survive which survive. If we claim that all genes are egoistic and atomistic only because they survive, however altruistic and

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[1021] E. Sober, D. S. Wilson, *Onto Others* (1998), pp. 31-50.

[1022] *Ibid*, p. 42.

systemic they may be, then by definition and not as an empirical result, all genes must be atomistic and selfish. It is, of course, inappropriate to simply excludes wholes from the semantic framework, since this does not solve but only conceals the crucial issues of the unit of selection or unit of evolution debate.

e) *Higher-Level Properties of Different Organisms – Four Possibilities for Achieving the Good of the Group*

In the last section higher-level genes (at different loci of one organism) have been shown to be possible. They can exist despite the meiotic shuffle and they are also stable if their components are less fit on their own. Hence it appears plausible that this also somehow holds for *alleles* in different organisms. In principle interaction effects of alleles in different organisms may exist in the different cases of alleles at the same locus, higher-level alleles and cross-loci interactions of alleles. Why should there be no evolutionarily stable synergetic wholes with a fitness effect in different organisms too?

Firstly, I shall discuss how far these two different types of wholes differ, in order to learn what conditions have to be met to transfer our successful result to this type as well. Secondly, I will give a survey of four different ways in which properties which are good for the group may evolve. The first discussion may be skipped, but it may help to clarify the functional difference of these two types of higher-level properties and also gives an, I think, interesting example of a selection above individual selection.

(i) Wholes in the Individual and the Many – Loci and Alleles

Despite the tautological undertones in gene-atomism, as outlined before, one should not forget the lessons which indeed had to be learned from the reasonable aspects of gene-atomism. Groups of members which altruistically support the group may be advantageous for that group, but, as has been pointed out by Dawkins and Williams in particular, these groups may be subverted from within by ruthless selfish genes or individuals. Gene-atomists came to conclude that no higher level of organisation and no true altruism can evolve since genes always only ‘aim’ at reproducing themselves. Anyone who wants to object to the gene-Darwinian view of life needs to show that not only systemic properties exist on a supra-gene level, but that these properties are also evolutionarily stable. This has been shown above for higher-level genes, now it needs to be shown for groups as well.

In order to do this, it appears helpful to work out the differences of higher-level properties of alleles at different loci in single organisms, $L_{11}\bigcirc L_{12}$ and of genes at the same locus or the same loci in different organisms, $L_{11}\bigcirc L_{21}$, $L_{11}\bigcirc L_{22}$, $(L_{11}\bigcirc L_{12})\bigcirc(L_{21}\bigcirc L_{22})$. Confer Figure 5. Since we are concerned with sexual organisms it is a simplification not to mention their populational background and that each organism has two alleles at each locus. However, this is enough to clarify the main differences:

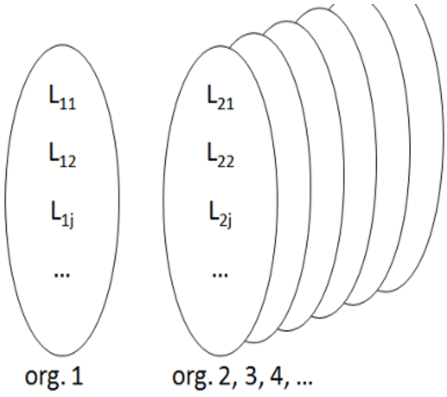

Figure 5: A simplified visualisation of different loci in the same and in different organisms, in order to clarify my terminology. The first index stands for the organism, the second for the locus. (For simplicity reasons the two different alleles of each locus *within* diploid organisms are not shown.)

(1) The components of a higher-level allele at different loci in one organism ($L_{11}\bigcirc L_{12}$) are coupled, whereas alleles being in different organisms are not. In sexual organisms they are, of course, mixed with each and every generation, but nevertheless they are coupled in the sense of having a common fate and are tied to the other alleles on the other loci at least as long as they 'inhabit' that particular individual, thus until that individual dies or reproduces.

> This does not entail, as is often simply assumed, that only those genes survive, which are most advantageous for individuals. We have seen that genes which are good on a higher level of individual integration will not always be evolutionarily stable.

(2) The distinction of genes at different loci versus genes at the same locus is usually conflated with the above distinction whether genes and their interaction are in one organism or different ones. In a single organism we are usually concerned with systemic effects of different loci, $L_{11}\bigcirc L_{12}$, whereas in different organisms we are concerned normally with the same locus in different organisms, $L_{11}\bigcirc L_{21}$. Although this is an important case, this conflation is obviously a simplification, since in sexual organisms there are firstly two alleles of the same locus, from the father's and the mother's side, and secondly we can also think of interaction effects of genes in different organisms at different loci, $L_{11}\bigcirc L_{22}$, (these interaction effects play an essential role in some of my following proposals).

If the genes of the same loci are alleles, they are competitors in the sense that one may replace the other at that locus. Genes at two different loci ($L_{11}\bigcirc L_{12}$, but also $L_{11}\bigcirc L_{22}$) may together become predominant in a given population. Besides additional preconditions for not being subverted in principle a common universal victory is possible for these genes. This is not possible for two alleles on the same locus in different organisms ($L_{11}\bigcirc L_{21}$, but alleles at the same locus in one organism).

To define an allele as being "synonymous with rival"[1023], nevertheless overstates the case, because in principle alleles may also cooperate with other alleles at the same locus (absolutely or relatively). This could be exemplified by heterozygote superiority (e. g. in the case of sickle-cell anaemia), where there is a negative interaction effect between two identical alleles in one organism. Although here the interaction takes place within an organism, this also leads to the advantages of a certain amount of allelic pluralism in a population.

Higher-level properties of genes at one locus of different organisms in any case have not to be limited to *different* alleles at the concerned locus. Traditional group selection has advocated a synergetic property of the *same* alleles at the same locus in different organisms. One normally concerned with altruistic alleles, which enhance the group fitness so much that their individual disadvantage becomes balanced by the advantage to the whole. Although in these group selectionist models the altruists are blindly altruistic to non-altruists as well (the alternative allele), the stability of this effect would be a synergetic property of the interaction of several altruist alleles in different organisms.

Nevertheless, there is still a difference between different loci in single organisms and one locus in different organisms even if in the latter case there are the same alleles at the loci of the different organism. This is because of the background of the populations which are basic to these processes. In this case subversion from within is still a much graver problem. In principle both wholes may become subverted. In the case of the same altruistic alleles at the same locus in different organisms, however, the very property which is advantageous for the whole, if supporting the other group members, in particular also supports the competitors of the genes with that altruistic property. In higher-level genes of one organism this could not happen since (mainly) different loci are concerned.

After this analysis we will better understand what preconditions facilitate the stability of higher-level genes. Likewise in this case stability is not trivial, since we have seen that certain populational preconditions need to be met if such a whole is not become subverted. In which way does the fact that we were concerned with alleles at different loci of one individual facilitate the possibility of genetic higher-level units? Based on the outlined coupledness of genes, providing that is they inhabit the same organism and on the fact that the whole that they build does not particularly support their rival alleles (we here neglect that diploid phenotypes have on each locus two alleles) we could distil two transferable facilitating preconditions for the stability of a whole. Firstly, the fitness effect is only shown when these genes together 'inhabit' an organism. Secondly, their synergetic co-operative effect also gives a fitness advantage for its composing genes and not for its competing alleles (neglecting the allelic loci within the organism). I have argued earlier that it would be wrong to deny the existence of a whole which is different from the sum of its parts, only because its composing parts profit from its existence.

[1023] R. Dawkins, *The Selfish Gene* (1989), p. 26.

> These facilitating preconditions for building a stable synergetic system which serve the common good are, as we will see later, not necessary. The stronger claim of sacrificing group selection will be discussed below.

I shall now consider whether the conditions which facilitate the stability of larger wholes in regard to inner-organismic higher-level genes of different loci can also be applied generally in the inter-organismic case. In regard to groups this would mean that synergetic properties have only to be shown if all (or many) members of a group have the underlying gene, and that the fitness effect, if it is shown, is profitable to those members which have this property in particular. It is difficult to think of a strict coupledness as in the case of inner-organismic higher-level genes. Still one is able to think of similar cases.

We may for example think of a pack of wolves hunting together and sharing their prey. This is group behaviour where something is achieved which one individual could not achieve on its own. If the food is shared between those who have hunted, it is those members in particular who are profiting from this synergetic property, who have created it.

The non-zero sum advantage of hunting together, clearly a group phenomenon, is linked here to the support of those genes which create this holistic effect. It seems that the only problem is that a gene frequency needs to become established so that the holistic effect comes into play frequently enough to lead to the predominance of the underlying gene in the population. A gene for hunting together only has its synergetic effect if others want to hunt together as well. Like in the above case of higher-level genes, $L_{11} \bigcirc L_{12}$, the establishment of an enhanced frequency can be achieved in the first place, for example, by a founder effect – a new population with a strong proportion of mutants.

But true gene-atomists would object that there may be a selfish mutant which is too lazy to hunt, but still tries to get the same share of the prey which had been caught. Equally all such group cooperations are in principle a riddle to gene-Darwinians. But let us assume that the pack would after a while somehow exclude this selfish mutant from eating, from reproduction or from the group generally. Then hunting together and its profit are again coupled.

It is indeed obvious that the selfish mutant who is too lazy to hunt, but still tries to eat equally from the prey of the pack, would under the above conditions become extinct. (For the time being we are not concerned with the possibility of an evolutionarily stable sacrificing altruism.) But despite our massively simplified assumptions this argument does not yet secure the stability of the synergistic system which serves the good of those who establish it. Additionally the stability of the genetic basis for exclusion of the selfish organism has to be considered as well.

> One simple solution of this problem would be to add the precondition that both properties, hunting and excluding the non-hunters from the profit, have to be based simply on one gene, in the gene-Darwinian sense a relatively short strand of DNA. Since genes mostly have

> many effects – they are polyphenic (pleiotropic) – this is not as implausible as it may appear.[1024]
>
> Another relatively simple solution would be that we were concerned with two genes, but they are again for some different polyphenic effect morphologically or functionally linked. But since I want to make my argument as general as possible, I do not want to rest my position on this assumption.

We assume that the two properties are based on genes at two different loci, which are not necessarily directly linked in any way. We are not merely concerned with another example of higher-level genes in the $L_{11}OL_{12}$ sense, since the advantage is a group advantage, communal hunting and sharing could only be done in a group. Whether in a larger group the hunting gene *H* and the excluding gene *E* are present in one individual at $L_{11}OL_{12}$ instead of in two different ones at $L_{11}OL_{22}$ is here only secondary.

We have assumed that in our population of wolves *H* and *E* are already predominant and is for example based on a founder effect. As mentioned above, it is obvious that an egoistic non-hunting mutant allele *h* will die out, because the *E* genes will exclude the lazy selfish individuals from the advantage created by the non lazy group. A more interesting question is whether the excluding gene *E* could not be subverted by a mutant gene *e* without this property. Indeed *e*-alleles might enter the population without being directly counter-selected, although in the long run they may cause a subversion of the systemic advantage of the group. But only as long as no *h* mutants are around, the *e*-allele is evolutionarily neutral. As long as this is the case the *e*-alleles will normally remain in the population without coming to predominate it. But if a *h* mutant appears, things change. The lazy non-hunter *h* may now be lucky in the rare case of him meeting two *e*-mutants with their prey (without any other *E*-wolf there trying to exclude him). In this case organisms with the *h*-allele will be lucky, but equally the *e*-allele organisms will be unlucky because they themselves become less of the food they hunted. Hence the few neutral *e*-alleles now presumably become less fit than the *E*-alleles and will be reduced in number. The case in which the h-mutant meets a group of e-mutants may occur so rarely, that it still gets excluded from the group advantage and becomes extinct. Hence the egoistic *h*-alleles will directly perish and as long as they are around the ignorant e-alleles will also have a disadvantage.

It follows that based on the interaction between different organisms and different loci, which is often ignored, a synergetic advantage which would not exist outside of the group and which is advantageous particularly to those which create this whole, could be evolutionarily stable and will not be subverted by selfish organisms, which try to profit from that group and do not contribute to it.

Below I shall argue that further radical cases of group altruism and group selectionism are possible. There the problem of subversion is graver. In this section the difference of loci and alleles has been clarified and an example of stable synergetic properties which are good for the group, involving a system of different interacting genetic loci on the population level, has been given. Here I only wanted to point out that less radical forms of cooperation and of synergetic properties exist, in contrast to

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[1024] Cf. for example: St. Gould, E. Vrba, *Exaptation* (1982/1998), pp. 60 f.; generally ➲ p. 316 f.

the assertion that there are merely selfish genes. Thereby I objected to the gene-Darwinian spirit that selfish genes always undermine systems which serve the common good. If the population itself is endowed with the necessary internal mechanisms to sustain the course favourable to the common good, a subversion of this system may become prevented.

(ii) Four Possibilities for Achieving the Good of the Group

In my view ruthless genetic egoism on the one hand and radical group selectionist altruism on the other hand are extreme ends of a range of possibilities. In the polemics of some gene-Darwinians it is often wrongly assumed that the absence of radical sacrificing altruism implies the selfishness of genes. But the absence of one extreme does not imply the other. Without the concept of higher levels one is caught in this dichotomy, taking it into consideration, the world has more grades and this dichotomy appears to be a false simplification.

> Sober and D. S. Wilson focus predominantly on group selection of sacrificing altruism. But they have acknowledged that group selection of what I call sacrificing altruism and mere altruism have to be distinguished.[1025] Nevertheless, as far as I can judge, they exclude lower levels of selection which may count in favour of group properties. This is the case although they have treated at length the fallacy of claiming gene-atomism tautologically. They may have excluded these phenomena, because these phenomena do not *necessarily* lead to higher-level properties, although they may lead to these properties. Although I agree with Sober and Wilson that gene-Darwinism could in any case be shown to be wrong, to neglect the differences below group selection leaves, I think, to much ground to this approach.

As I have elaborated in the above section on the tautological definition of gene-atomism, it is not only reasonable to distinguish between ruthless egoism and sacrificing altruism, but also between ruthless egoism undermining a synergetic whole and the stabilisation of a system which is advantageous to the whole, even though the composing genes profit from it. We of course normally want to make a difference between a criminal robbing a bank and someone who is conscientiously working for a bank (thereby I do not want to claim that people working for a bank could not become criminals).

In the above example, the genes, although not altruistic in a self-sacrificing way, are sustaining a system which is advantageous to a larger whole of contributors to that system, but also to themselves. It is a group hunting co-operatively and the excluding selfish mutants, which try to make use of the advantage of the group without contributing to that result is part of a strategy, which could secure this system. It would be wrong to redefine such an example in terms of gene-atomism and gene-egoism. Besides the reality of single genes, a system has been established which changes the paths of evolution. Now a higher over-all fitness is achieved and individuals become advantaged who are, albeit not totally self-sacrificing, less ‘selfish’ compared with alternative alleles. They do not exploit and undermine the common good. A redefinition in terms of ruthlessly selfish genes misses the relevant questions

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[1025] E. Sober, D. S. Wilson, *Onto Others* (1998), p. 30.

of the dispute and in its resulting simplified philosophical message is, I think, simply outright false and dangerous.

Based on these considerations I now outline four ways in which properties which are advantageous for a group may become established. For the time being (despite differences) I follow Dawkins, Hull and others in distinguishing the profiting units of replication (on the genetic side) and the units of interaction. I showed earlier that in sexually reproducing organisms selection of individuals, against a common simplifying assumption, does not necessarily, but may lead to an adaptation on that individual level. This depends on frequency and fitness distributions in the basic population. Here I argue that 'lower' types of selection can also lead to advantages for higher types of entities.

In particular the mechanism which I propose for systemic individual selection may be interesting where the interaction of several loci of different organisms is shown to lead possibly to a systemic stability of group properties, although without relying on group selection. Treating group selection in structured populations I largely rely on Sober's and D. S. Wilson's approach, but I add a proposal whereby the applicability of this model is strongly extended. Group selection of whole populations if combined with systemic individual selection may according to my proposal lead to stable wholes, even without the need for permanent group selection.

(1) *Individual selection which may promote the common good.* To state this possibility may appear trivial, but I think it is not as trivial as one might think and anyway gene-atomism has largely concealed this possibility.

Let us assume that the running speed of deer evolved because it benefited the individual organisms.[1026] For this trait only individual selection should play a role and it is assumed that neither synergetic properties nor a system of individual selection exist (➲ pp. 291 f.). Only those individual deer would have been successful in surviving which could individually run fast enough.

> We are hence concerned with absolute fitness values of individuals, but in principle one may construct similar arguments using relative values (not running fast but running faster than the rest in the group).

For assuming an individual selection of the trait of running speed we in my view do not need to stipulate that deer in general are in all respects selected individually.

Despite these assumptions it is in my opinion still possible that the survival of the fastest individuals, as a side effect, is also good for the group or for the species. The main objection to this claim is that in regard of this trait it does not make sense to speak of a larger whole which may benefit from this selection on the individual level, because according to the above stipulation, there is no such whole. Nevertheless in a selectionist context the intuitive claim that the individual good may sometimes lead to the common good can, I think, be justified. Here three possible arguments supporting this view will suffice.

[1026] Cf.: E. Sober, D. S. Wilson, *Philosophical Work on the Unit of Selection Problem* (1994/1998), pp. 199, 203.

(a) If we can not speak of wholes in regard to the particular trait of running fast, but we actually aim to distinguish whether individual selection does at the same time undermine a synergetic whole, we still may take other traits in that group into account, which may have a synergetic group property. Presumably, a greater individual running speed will not strongly undermine any other traits based on group selection. This, of course, would need to be analysed in each case and is a matter of degree. But in the example of the pack of wolves hunting together, a subversion of the allele for the exclusion of the cheater by individual selection, would clearly subvert the synergetic property of hunting in groups.

(b) Individual selection may even increase the fitness of a group, at least in the sense of the fitness of all its members. We assume a second trait that the group would always to some extent wait for its slowest members, which should be stable for another reason, for example because it is advantageous for vital group coherence. It would result that the fitness of all group members would be partly dependent on its slowest member. Although this leaves the austere world of redical individualism, running speed should still predominantly be selected individually; the slowest members should still be the easiest prey for predators. Individual selection eliminating very slow deer, would have a particularly positive side-effect for the fitness of each other member, by enhancing their absolute fitness (here the resulting running speed). Hence, although the physical running speed itself is based here on individual selection, its interaction with the waiting trait leads to an increase of the fitness of all members of the group.

(c) The most relevant positive side-effect of individual selection for a group may be that the group does not become extinct in the long run. Permanent individual selection pressure for running speed may also lead to a herd with enhanced running speed, which then may survive a new more dangerous species of predators migrating into their habitat. Survival is at least in some respects in sexual organisms a property of an evolutionary line, because no organism can reproduce alone and all genes come back to a gene-pool. An early strong selection pressure on individuals may *sometimes* lead to the survival of the group or species as a whole.

These examples are obviously not meant as an exhaustive treatment of how individual selection may lead to group advantages. Definitely many aspects need closer scrutiny, further distinctions could be made and a classification might be developed. Here I only wanted to point out that this matter is neither completely trivial nor only leads to negative results.

Individual selection does of course not necessarily lead to the good of the whole and to the good of most members of the whole. The subversion of altruist synergetic groups by selfish genes or individuals is the prototypic example where lower levels of selection lead to a disadvantage for the whole and thus for most of its members. Nevertheless, gene-Darwinism has concealed that sometimes lower levels of selection may, as a side-effect, also lead to an advantage for a higher-level. If gene-Darwinians do not contradict this claim explicitly, their approach in any case is different in spirit.

(2) *Systemic individual selection*. This proposed type of selection is not based on group selection and can not guarantee that only properties which are good for the group

come into being. However, it likewise differs from plain individual selection, because a system of individual selection may determine the direction of evolution which is not explicable in terms of individual selection only. The whole is not understandable if one only looks at its parts. By chance or with only a little help of group selection, properties which are good for the group, but perhaps disadvantageous for the selfish individual, could become established by systemic individual selection. Systemic individual selection could, as I argue in the following, stabilise a property which has been established by group selection without the further need of group selection.

(a) A first type of systemic individual selection concerns selection of alleles that are selected dependent on the frequency of other alleles in a population.

Take, for example, the model of indirect reciprocity by Nowak and Sigmund. In a kind of successive prisioner dilemma situation individual selection causes cooperators to be outcompeted by defectors. But what happens, if one considers the following system of three alternative strategies: cooperating, defecting, and discriminating (here: cooperating only with those who have previously cooperated)? Nowak and Sigmund have shown that in the presence discriminators, the strategy of cooperating may become evolutionary stable. Moreover, also the strategy of discriminating depends on the frequency of the other strategies. So there is a mutual dependency. Under certain conditions a particular distribution of discriminators and cooperators can lead to an evolutionary stable system of strategies in a population.[1027]

Although such situations are not concerned with group selection, it would be inadequate to characterize them as being governed by individual or gene selection only, since not single genes but configurations of genes are evoluaionary stable.

(b) A second type concerns different genetic loci. The example given is linked to sexual selection, but one may also think of other examples without mate choice (cf. the earlier example concerning the traits ‘huntering’ and ‘excluding lazy hunters’).

Let us considering, how for a pack of wolves the bravery of the attacking wolves could be evolutionarily stable. One possibility, discussed below is permanent group selection among those packs with at least some brave individuals, which have a higher overall fitness. Taking other loci into account, how could such a genetic system, leading to the good of the group, could evolve without the existence of group selection. Let us assume (in the usual simplifying way) that there is a mutant gene *B* for attacking prey in a particularly brave way. In standard terminology, a *B*-wolf is an altruist in making more effort and risking more than others in order to achieve the common good of bringing down the prey. This task could not be achieved by one wolf on its own. Now this gene, although good for the group at large, will not be evolutionarily stable. This is a kind of prisioner dilemma structure. The gene may nonetheless become established in a population for example by a founder effect, but in absence of group selection it will soon be subverted, because it is disadvantageous for the bearer. It will soon be outreproduced by less brave and comparatively selfish *b*-mutants. Hence, mere individual selection would lead to the extinction of *B*.

[1027] M. A. Nowak, K. Sigmund. The dynamics of indirect reciprocity (1998); M. A. Nowak, K. Sigmund.. Evolution of indirect reciprocity (2005).

But if a system of interacting gene loci is considered, each regulated by individual selection, things do not remain that simple. Given, for example, that reproduction in these wolves would be based on female choice and that each of the wolf bitches only reproduces a few times. If a gene *C* were predominant in this pack that the bitches prefer to choose to mate with brave male wolves (*B*), the tables would have turned: the *B*-gene, which is also good for the group at large, will soon be more frequent than the comparatively selfish *b*-gene.

But this is not really conclusive yet; it needs also to be shown that the choosing gene *C* is stable in the population. Mutant *c*-alleles appear to have an advantage if they would not always mate with the individually non-fit altruists, who always risk their life, and whose offspring will later often have the same individually disadvantageous property. But this conclusion is not valid, as long as *C* alleles are predominant in the population. The brave wolf and its descendants will actually, based on the interaction with the *C*-genes in other organisms, be better off. Of course if c-alleles already dominated the group, *B* and *C* would not become evolutionarily stable. A founder effect, genetic drift or group selection would be needed to first establish these starting conditions preferable for the whole, which then would be stable.

It has been suggested, that groups need not become subverted by selfish organisms or genes, even if this is not secured by group selection. However, if certain conditions are not given, such a system may collapse. But claiming theoretically that such system does not exist and that there are nothing but atomic and selfish genes, is committing the outlined fallacy of claiming gene-atomism tautologically (➲ pp. 277 f.). One may of course somehow redefine the systemic whole which has changed the adaptive landscape of each gene in terms of single genes, but this would miss the point of what is implied by 'system'. One may also reinterpret the gene *B,* which was advantageous for the group, as being truly a selfish gene, since it ultimately survives and becomes evolutionarily stable. Any result can be redefined in this way, including the more radical forms of group selection, treated below. The composing genes have always survived, but it of course makes a difference if they survive because they serve a larger system or not. Here systemic individual selection leads to the stabilisation of genes with synergetic properties which are advantageous for the whole (in this sense they are not merely individual genes), although they would not have been advantageous on their own. Moreover, this system under certain conditions prevents the subversion by selfish individuals.

Although systemic individual selection may stabilise synergetic properties which are advantageous for the common good (here still simply for survival), it needs to be pointed out that this does not necessarily lead to the adaptation on the group level.

> In principle one may imagine that in the preceding example the situation would have changed so that bravery of individuals would not be adaptive any more for the group. Nevertheless systemic individual selection would up to a certain point still sustain this property. The assumption that bravery becomes disadvantageous for wolves is implausible; it may in some respects be more plausible for humans, who also have a cultural system of medals, honours and personal appreciation supporting bravery. However, the point is that such a system could have its own stability and inner dynamics to some extent autonomous from external selection pressure.

One may think of the enormous antlers of the palaeontological titanotheres or of present species of deer. It has often been argued that the enormous size of the antlers in some cases is not adaptive, neither for the individual nor for the group.➲[1261] Something like this, as I will discuss later, may well evolve through systemic individual selection. In a way it may be wrong to call this evolutionary process selection at all. Although this is a type of selection in the trivial sense that some survive and others do not survive, it does not fulfil the externality of the selection process which is normally implied by this term, particularly in an adaptationist Darwinian context.

It may appear disappointing that systemic individual selection leading to an autonomous system level above individuals, does not ensure that this system is best for the group. Actually, as given in our example systems which are advantageous for the group, could and presumably often are stabilised by such a kind of organisation. If this is not based on chance, it at least needs one instance of group selection (➲ below). However, the process itself indeed gains a certain autonomy. This need not to be understood as a problem, instead it may point to the fundamental fact that evolution is not only an adaptation to an outside environment, but also has inner tendencies of its own, transcending individual *and* group selection.

This work started with an interest in the evolution of the biological basis of morals. The outlined process firstly shows that adaptations which are good for the group, could be sustained based on certain frequencies and gene interactions in a population. Secondly, this is a basis for an internal definition of what becomes selected. Inner tendencies of groups may come to lead evolution in new directions, which are not necessarily adaptive on the whole, but in which in any case the individuals are urged to adopt. Although parts of our moral presumably serve the survival of the whole, helping the weak and wounded is not necessarily adaptive (at least not in any direct sense), neither for those individuals who show this behaviour nor for the group as a whole. This may point to the deeper truth that evolution is not only an adaptation, but is the establishment of new principles which from within may direct the further development. (For a treatment of auto-selection and autonomy ➲ pp. 394 f., pp. 409 f.)

(3) *Group selection in structured populations*. Group selection directly relates to the fitness of groups with advantageous synergetic properties.

> Many group selectionist models require that one *group* has an advantage over another to speak of group selection, similar to when one normally speaks only of a gene which may become selected if there is an alternative allele. "If all groups are exactly alike, there can be no group selection."[1028] Although this may be controversial, it will not be discussed here, since I only want to show that it is in principle possible that traits could be and are stabilised by group selection, because they are good for a larger whole. I only present one model here and make a proposal to extend the conditions of its applicability.
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> Everything which is advantageous for a larger whole, but is not directly advantageous from the perspective of the individual or of the gene requires *altruism*. In evolutionary parlance no consciousness is required for 'altruism'.➲[93] Altruism is understood as a general matter, including all properties and all behaviour that is good for a larger group or for one of

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[1028] *Idem*, *Onto Others* (1998), p. 47.

> its members. This of course does not imply *vice versa* that every altruism, where single organisms without an advantage help group member is necessary advantageous at the level of the group. This has to be shown in each particular case. However it is commonly accepted that we could think of properties which are good for the group; gene-Darwinians normally only argue that such properties could not be stable based on this effect. I have worked out above that it is not always necessary that advantage of group properties have to be disadvantageous to its bearer. Hence sometimes altruism, instead of sacrificing altruism, is involved. Still sacrificing altruism remains a particularly important question.

I distinguish group selection of structured populations and group selection of whole populations. For structured population models groups do not need to be wiped out completely. The assumption behind structured populations has been central for the second phase of the evolutionary synthesis.

Group selectionist models of structured populations differ considerably. They vary, for example, in regard to the assumed population structure, the conditions of mating, the mechanism of population subdivision, the selection pressures, the coherence of subpopulations or the incorporation of migration. Lloyd provides an overview of the differences of possible models referring to more literature on this topic.[1029] Each model has its own advantages and constraints. They partly even contradict each other, but there may well be different valid models for different conditions.

For simplicity reasons I here only summarise one model which has been proposed by Sober and D. S. Wilson.[1030] Their model is restricted to certain conditions and it may also be treated as a model of a selection of whole groups. I shall add a proposal as to why their model could more generally be applied to groups of relatively small size, which mix with the basic population, in any case resulting in a model of structured populations par excellence. Sober and Wilson show that group selection in structured population can also lead to the evolutionary stability of sacrificing altruism. Sacrificing altruism presupposes that the organism which supports the whole or which helps other members has an evolutionarily relevant disadvantage on the individual level. The fitness of an individual who is a self-sacrificing altruist is by definition, in regard of mere individual selection, lower than that of the egoist. The synergetic advantage for the whole is here not coupled to the advantage of the individual. The problem is clear. If no synergetic multi-loci-system of individual selection secures the stability of that trait, as shown above, altruism will soon decline, even if advantageous for the group. How could group selection lead to and stabilise an adaptation on the group level?

[1029] E. Lloyd, *The Structure and Confirmation of Evolutionary Theory* (1988/1994), pp. 48 f. see also M. J. Wade, *A Critical Review of the Models of Group Selection* (1978). On the relationship of group selection and kin selection: E. Sober, D. S. Wilson, *Onto Others* (1998), pp. 55 f.; E. O. Wilson, *Kin Selection as the Key to Altruism: Its Rise and Fall* (2005).

[1030] E. Sober, *What is Evolutionary Altruism?* (1988/1998), pp. 463, 470-474. E. Sober, D. S. Wilson, *Onto Others* (1998), pp. 23 f.

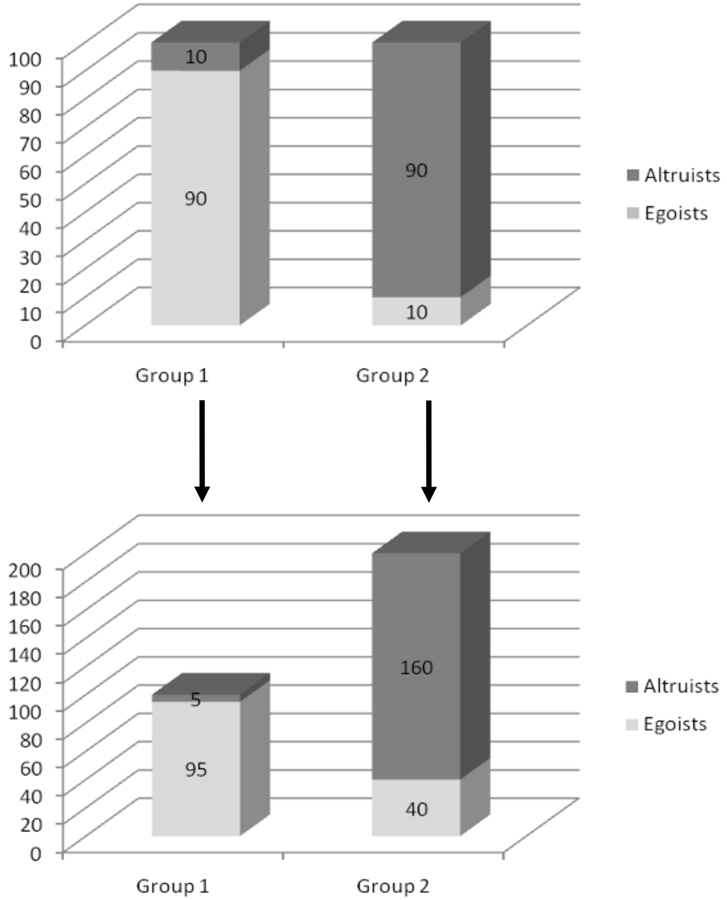

Figure 6: Although the proportion of egoists within each group increases in each generation, the proportion of altruists rises in regard to the total population, because the group advantage in this example more than balances the individual advantage of the egoists. Please note the differences on the y-axis. (Similar to Sober and Wilson, 1998, p. 24.

Figure 6 shows that, albeit altruism is less fit within each group and will decline in every generation in each group where egoists are members, the synergetic advantage of a group with a high number of altruists could lead to quicker multiplying of the average member of those groups. Although this has also a positive effect for the egoists and the proportion of altruists decreases in each group, this could be balanced by the different contribution to the total number of offspring. Without here calculating the involved frequencies in detail, Figure 6 gives an impression of possible outcomes.[1031] The frequency of altruists in the two populations, taken together, first was 50%. Although the frequency of altruists in each population has declined in one (or several) generations in the largely egoistic group from 10 % to 5 % and in the largely altruistic group from 90 % to 80 %, the altruists on the total, paradoxically, have increased not only in number but in proportion! Now in our hypothetical total population 165 altruists and 135 egoists could be found. The relative frequency of altruists although falling within each group increases from 50 % to 55 %.

> Sober calls this non-intuitive statistical phenomenon that something on the whole may increase, although it decreases in each sub-class, in tribute to a statistician, Simpson's Paradox.[1032]

This model requires the additional assumption that from time to time new groups are formed otherwise the subversion effect within each group becomes stronger than the group advantage of altruistic groups. This differs for example to my above proposal of systemic individual selection, which could stabilise properties advantageous for the group and which requires a certain basic frequency within a group to be stable. Here, the groups need to be different enough in their composition that the difference of their synergetic effects can be 'seen' by group selection. This variation may be provided by certain population structures. Sober argues that this can be achieved by a permanent fragmentation particularly of the quickly growing altruist groups, without a mixing too strongly with other populations.[1033] These groups will statistically vary in their composition. Sober and Wilson have also pointed out that this assumption is given in the case of sibling groups. Here in sexually reproducing organisms the frequency of 50% or of 100 % altruists could easily be achieved.[1034] Although this is close to what has been called kin selection, Sober and Wilson show that this is a kind of group selection through working on kin groups.

> This, according to Sober and Wilson has actually even been advocated by W. Hamilton himself, who has contributed much to the development of the theory of kin selection. In his later publications, particularly in an article from 1975, Hamilton, based on equations developed by G. Price, has reconsidered his theory of inclusive fitness as representing a multilevel selection process. This continues to be ignored by gene-Darwinians.[1035]

I want to propose two extensions of the conditions where these requirements for stable group selection could be met, where no fragmentation but a mix and a formation of new groups is sufficient. Particularly the second proposal may be of interest.

[1031] For E. Sober, D. S. Wilson, *Onto Others* (1998), pp. 23 f.

[1032] E. Sober, *What is Evolutionary Altruism?* (1988/1998), pp. 470-473.

[1033] *Ibid,* p. 474.

[1034] E. Sober, D. S. Wilson, *Onto Others* (1998), pp. 62 f.

[1035] *Ibem*, pp. 71-77. Cf. E. Sober, *What is Evolutionary Altruism?* (1988/1998), his footnote 9. Cf.: R. Dawkins, *The Extended Genotype* (1982), pp. 187 f.

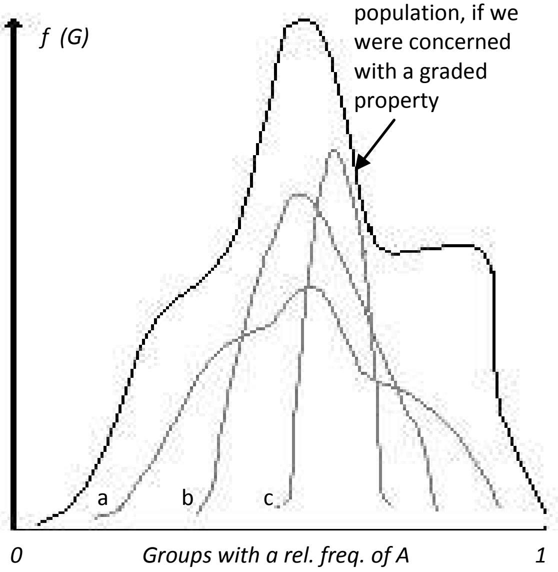

Figure 7: The distribution of the number of groups with a certain relative frequency or mean of altruists. The groups in each graph are randomly chosen out of a main population. Graph *a* may represent the means of 100 groups with the group size *n* = 2. Graph *b* 100 groups with *n* = 10. Graph *c* for *n* = 20.

(a) There may be the possibility that phenotypic altruists may recognise other altruists to form a group, 'in order to' guarantee that differences in groups are found. This altruism would not have to be based on the same genes and no siblings need to be involved.[1036] The alternative blind formation of groups regardless of the properties of its members anyhow appears bizarre, particularly in regard to 'higher' organisms. (However, this assumption is usual of most models which for mathematical reasons have to be simple.)

(b) Groups which should vary enough can also be formed 'blindly', regardless of the properties of their members. Besides the conditions mentioned above, I shall show that Sober's and Wilson's model is also applicable, if the groups mix again and again with the basic population, even if they formed again in a random way and if no sibling structure were involved. It may appear that this would lead to groups which always have a number of altruists similar to the average of the population. But in my view this could be prevented if the formed groups are small enough, that they strongly vary by chance. In regard to small groups the statistical central limit theorem does not become applicable. Simple statistics could show that the average of compositions of each subpopulation (here the relative number of altruists) varies on average strongly from the average composition in the basic population if the normal population size of the subpopulation is small.

[1036] This proposal in my opinion has not to be conflated with mere reciprocal altruism. Although, in any group selection, the individual somehow in average profits from the group, in group selection the synergetic property is essential, which is not necessarily given in the case of reciprocal altruism. Moreover, I have also argued that reciprocal altruism already transcends strict gene-Darwinism. (Cf. also the subsection on claiming gene-atomism in a tautological way, ➲ pp. 277).

What in textbooks of statistics is taken as a sample of a larger population to estimate a variable, for instance the mean value, of a certain property in a basic population, here could be seen as a group. The property we are concerned with is altruism.

Whereas one is usually interested in getting an as adequate measurement as possible, here we are interested in the opposite. When does the mean of the altruistic property in different groups vary enough from the mean of the total population to allow group selection to play a central role? The statistical central limit theorem shows, as visualised in Figure 7, that independent from the form of the distribution of the basic population, the distribution of the means of different groups (or samples) of n members (or observations)[1037] approaches a normal distribution, as n becomes high enough (normally, $n > 30$). Confer the graphs of a, b, c. More important is that this normal distribution of means of different observations (groups), has the variance of s^2/n (where s^2 is the variance of the population, which is not depicted). This implies that the smaller the groups are, the more they vary on average in their mean from the populational mean, even if the groups are random samples.[1038]

> Normally one also depicts the population structure in such a graph. Since we are concerned with a dichotomic property, 'to be or not to be altruistic', this would have resulted merely in two columns one at 0 the other at 1. It makes more sense to depict a graded property (which I have done only as an intuitive help). Normally the central limit theorem is used for cases with a graded property. Sober's and Wilson's model will presumably also work similarly with graded properties, but this would need to be shown in detail, since the basic model would need to be modified. However, the central limit theorem is applicable to *all* forms of basic distributions. Hence I have confined myself to this case.

This shows that under the condition of small group sizes sufficient variance of the mean of the involved groups may be given, even if random group formation is assumed. Hence also small group sizes appear to fulfil the conditions required for Sober's and Wilson's basic model of group selection.

(4) *Group selection of whole populations.* Another possibility of group selection is the wiping out of whole populations. In popular presentations of evolutionary biology this is sometimes falsely presented as the one and only model of group selection. I shall only mention it shortly and also only mention the possible combination with the proposed systemic individual selection.

Let us assume that a group or a species of altruists which are advantageous for the group had become established by the founder effect or by genetic drift (phenomena well studied by the evolutionary synthesis). Now, the problem of subversion from outside and from within may become pressing. One simply could assume that if egoism becomes too predominant in a group this group simply will not survive,

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[1037] There is a difference between observations and groups relevant to the central limit theorem in its normal form. Observations are usually understood as random samplings *with* replacement, whereas the application above on groups is actually a random sampling *without* replacement. In our model members can only be member of one group. Also if we do not want to change this assumption (this would be interesting as well) the general lesson from the argument is in a different formulation also applicable to random sampling without replacement.

[1038] See, e.g., J. Bortz, *Statistik* (2005), pp. 91 f.

whereas other will. Similar to Sober's and Wilson's original proposal above, only assuming complete isolation, the permanent division of successful groups and the frequent elimination of whole groups could stabilise the altruistic trait. But one may also think of two other ways in which a subversion may be prevented without the need of permanently wiping out whole groups.

(a) The concept of evolutionary constraints may provide the possibility that something which is advantageous for the group, but not advantageous for a single selfish gene, may once become established and may than be stable for other reasons. The concept of structural constraints has recently been reanimated for example by Gould and more radically by Goodwin. Evolutionary constraints stress that because of certain morphological (or functional) necessities not all directions are open to evolution. According to this view, pathways, once adopted, may have an inner direction, which do not allow their subversion.

I shall also argue that the phenotypic structure is not only a result of the genome, but itself also an evolutionary factor, channelling possible evolutionary pathways (➲ pp. 324 f.).

(b) Group selection may once establish a system of individual selection, which is advantageous to the group and is kept stable by the inner stabilising dynamics of the system. In this case only the installation of such a system requires group selection. (This concept will be treated in more detail when discussing species selection below.)

Without such modifications frequent selection of groups is required. However, the elimination of groups in some species may play a role. Also in regard to the human species this might have played a role, if tribes were permanently at war with each other. But this is obviously not a promising model for the present day sociobiology of humans. If we indeed want to treat such matters biologically (I would advocate a relative strong autonomy of cultural aspects), there are, as have been shown, other alternatives to strict gene-egoism. In regard to present human sociobiology I would generally prefer a structured population model of the advantage of social groups, which mix with other groups, and also my model of auto-selection, because these models appear more adequately to resemble the presently given situation. Additionally, we should not forget that scientific models of human behaviour may also have the aspect of a self fulfilling prophecy.

To sum up, there are at least four different ways, in which the good for a group may become achieved: individual selection, systemic individual selection, group selection in structured populations and group selection of whole populations. It has been shown that systemic individual selection may gain some autonomy relative to mere individual selection and if combined with group selection may secure the good of the group without the need of permanent selection. In regard to the presented group selectionist model of E. Sober and D. S. Wilson I have shown that its applicability could be extended to all groups which mix with the population, if the usual group size is small enough to guarantee the required inter-group variation.

Finally, I would like to add a few remarks on an intereting recent debate in psychology and behavioural economics on human altruism. This debate shows that humans are actually much more altruistically than one would have to assume on the basis of gene-Darwinism and neo-classical economics.[1039]

Rigidly controlled experiments have shown that most humans do not regularly behave like assumed by the egoistic *homo economicus* model known from economics. Instead they often aim to act in a just way, even if this involves truly altruistic behaviour and high costs. Although the experiments regularly use anonymous settings, please note that the altruism found in such experiments is not blindly distributed, but bound to criteria, like justice in particular (see research on the so-called ultimatum game or dictator game[1040]).

Moreover, in common good and prisoner dilemma situations it has been shown that the undermining of group-serving behaviour by egoist defectors can be prevented if other players can punish defectors. The experiments were designed in a way that punishment involves costs for the punisher and ultimately altruistic, group-serving behaviour. Hence, Fehr and collegues have justly called this phenomenon 'altruistic punishment'.[1041]

Interestingly this altruistic behavioural phenomenon on the one hand requires the evolutionary assumption of one or another kind of group selection, since there is a selection pressure against the punisher. However, given the system has evolved (for instance by a founder effect), much less group selection is needed than without altruistic punishment, since punishment selects against defectors, and due to the resulting low number of defectors the negative effect on the altruistic punishers gets low. Hence, this idea provides us with an example how an additional mechanism may reduce the required force of group selection to keep up an equilibrium that is good for the group.

f) Stable Synergetic Properties and Selection above Groups – Species and Ecosystems

Also at higher levels selection is conceivable. This has been proposed in the evolutionary discourse for species as wholes and in principle also for synergetic systems of several species up to whole ecosystems.

It is questionable, as is in regard to group selection, whether the term natural selection could be appropriately applied in the sense of a full Darwinian process of blind variation and external elimination. Another less Darwinian proposal would be that only the second step of this process, differential external elimination, comes into play (➲ definition of Darwinism, pp. 102, 358 f.). Differential external elimination of synergetic wholes appears to be enough to make such wholes evolutionarily relevant (the evolutionary stability has to be discussed in any case). It may still be an interesting question whether there is a Darwinian blind variation of species and ecosystems? In regard of species this has actually been proposed. In the subsequent Chapter 9 the transcendence of universal process Darwinism will be discussed. Here I am not primarily concerned whether the particular evolutionary process is strictly Darwinian, but rather whether these higher levels of organisation could in any case reasonably be said to exist and possibly also secure their own stability. Here I can only touch upon the discussions on the possibility of the evolutionary relevance first of species and secondly of systems of species up to ecosystems.

[1039] Cf.: J. Bauer, *Prinzip Menschlichkeit* (2006), Chapter 6.

[1040] E.g., J. Henrich, R. Boyd; S. Bowles; C. Camerer; E. Fehr; H. Gintis; R. McElreath et al, *"Economic man" in cross-cultural perspective: Behavioral experiments in 15 small-scale societies* (2005).

[1041] E. Fehr, S. Gächter. *Altruistic punishment in humans* (2002). Fehr, E.; Fischbacher, U. *Social norms and human cooperation* (2004).

(i) Species

The evolutionary relevance and the selection of species in the present discourse has early been advocated by Ghiselin[1042] and Hull. Hull has explicitly understood species as 'individuals', having a beginning and an ending in time and exhibiting a certain degree of integration. According to Hull, the evolution of such 'individuals' could be modelled along Darwinian lines.[1043]

In biology particularly Gould and Eldredge have defended the autonomy of the explanatory level of species and argue that the involved processes are at least similar to those of Darwinian individual selection.[1044]

Prior to this, the proponents of the evolutionary synthesis, Wright, Dobzhansky and Mayr have in principle also supported the existence of species as an evolutionary factor. They advocated that the species is the unit of evolution which provides a basic frequency distribution of genes. To them the phenotypic structuredness of a population, caused partly by environmental, is evolutionarily relevant and an evolutionary factor. The concept of species in this view is linked to a number of properties and evolutionary factors like sexual reproduction, recombination, migration and isolation. Additionally, at least some advocates have even advocated the possibility of species selection along similar lines to individual selection, i. e. a blind overproduction of species and an external selection (➲ pp. 127 f.). Heretofore, for example Wallace advocated that the species is itself a unit of selection (➲ p. 112).

The properties and evolutionary factors linked to the concept of a species, in my view pose the question, how far a species should be regarded as being an object of selection or in how far it itself changes the process of evolution. At least for reasons of comprehensibility, I think, we better distinguish two aspects of the reality of species, on the one hand the existence of the basic properties of a species, which change the character of evolution itself and on the other hand the result of the selection process of different species with possible adaptations on this level.

The basic properties which more or less define the very existence of a species, like a common gene pool, recombination of genes, the building of subpopulations, the possibility of isolation, inner-specific migration, founder effect etc. already make the reality of species, transcending the individuals, apparent. But why should these properties make the species real? In my view these properties are themselves changing the very process of evolution. Inner-specific groups which we have treated above only become possible based on the existence of interbreeding populations. But also the very notion of single genes becomes only reasonable based on meiosis in sexually reproducing organisms, transcending the asexual evolution of whole organisms and

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[1042] M. T. Ghiselin, *A Radical Solution to the Species Problem* (1974).

[1043] D. Hull, *Are Species Really Individuals* (1976); *Individuality and Selection* (1980). Cf. the proposal of B. Mishler and R. Brandon to decompose the different aspects of the notion of individuality, *Individuality, Pluralism, and the Phylogenetic Species Concept* (1987/1998), pp. 300-305.

[1044] N. Eldredge, S. J. Gould, *Punctuated Equilibria* (1972); S. J. Gould, N. Eldredge, *Punctuated Equilibria* (1977); cf.: E. Lloyd, *The Structure and Confirmation of Evolutionary Theory* (1988/1994), p. 97; St. J. Gould, *The Structure of Evolutionary Theory* (2005), Ch. 5. (On punctuated equilibrium ➲ p. 149).

their genomes (also the concept of higher-level genes, presupposes single genes in the first place). Genes as treated by population genetics are dependent on the existence of interbreeding populations. Semi-isolated gene pools are also necessary to sustain the variability on the species level, but equally for evolution on lower levels. But, likewise, phenotypic properties of a species like geographical isolation contribute to the way a species evolves too.

The existence of species makes evolution quicker and less blind, and also changes the direction of evolution. Based on recombination new genetic combinations could be found more quickly. From the viewpoint of the evolutionary line, now the species, this process is less blind, because these combinations are tested in subpopulations, and if successful may become predominant. Before new species evolve much will have been 'tested' before, within a species. Based on new combinations and on the fact that some genes are recessive, 'valleys' of an adaptive landscape could be crossed which could not be crossed before. But, what is even more important, also the adaptive landscape itself changes. If an evolutionary line is a species, as outlined, the evolution of inner-specific groups, as discussed above is possible and even probable. (➲ Chapter 9, on the evolution of evolutionary mechanisms.)

It is cardinal that a species is a central unit of heredity in the sense of our earlier emphasis on genetic context. All genes, all high-level genes and all gene-pools, although they may vary in their reproductive rate, are part of this river of information. The species, as interbreeding population, is the ultimate context in which all lower units are finally interpreted. However, this does not yet guarantee that all evolutionary products of the species are for the good of the species.

Nevertheless these properties of a species, as far as they change the process of evolution, are in a way inherent in all adaptations which result from this changed process. The crossing of valleys which would not have been crossed otherwise, the change of the adaptive landscape, are products of species, in the sense that if the species would not have existed these things would not have happened. Therefore, species appear to be real in the sense that they change the very process of evolution itself. Although most evolutionary results in a species appear to rely on the basic properties which a biological species has, not all aspects which are enabled by the very existence of species lead to the good of the species.

We come to the second aspect, that of the selection of species and whether properties could be established which are for the good of the species.

Egoistic genes, which may have an inner-specific advantage at the cost of the adaptation of the whole species, may gain dominance in the species.

It appears that species selection is the only way that this could be prevented.

I have outlined above, that it has often been argued that the general properties of a species, could lead to the process of species selection, similar to the neo-Darwinian concept of individual selection. (Actually, as mentioned, I think that variation on the species level is less blind, because combinations usually become tested before a new population becomes founded. On blindness, ➲ pp. 368.)

Species selection and the problem of subversion could be understood in a similar way as the selection of whole groups, only a species is a group which is, reproductively, completely isolated from other such groups. Correspondingly, again a frequent selection of species appears to be required if subversion is to be prevented. To arch-Darwinians in particular this precondition should be no problem, since to them evolution anyhow consists almost only of blind allies.

Subversion may also be prevented by the existence of evolutionary structural constraints (➲ p. 300). Another possibility would be that species selection leads to the installation of what I described as a systemic system of individual selection, which has a stability against egoistic subversion (➲ pp. 291 f.). Such systems, as we have seen, have a certain autonomy relative to mere individual selection, but do not necessarily serve the group or the species. But if such systems which is advantageous on the species level once becomes established by species selection, this systems sustains it own inner stability. Species selection would only need to change these stable selection systems if they become non-adaptive for the species because of an environmental change or the inner evolution of other loci in the gene-pool.

Species selection has often wrongly been understood in isolation from other evolutionary mechanisms. Here a combination of species selection and systemic individual selection is proposed, which, I think has a synergetic property and each on their own do not have. If both concepts are combined it becomes possible that adaptations for the good of the species are installed by species selection, but are stable without the need of permanent species selection. This may help to explain why some adaptations on the level of species, have not been undermined by selfish genes, if permanent elimination of species is, likewise, no plausible assumption.

(ii) Ecosystems

Ecosystems are obviously less integrated than species are. Different species are not reproductively linked to each other as the genes or sub-populations of a sexually reproducing species are. Moreover, ecosystems – unlike species – do not in any obvious way build evolutionary linages and thus an analogy to individual selection is less complete.[1045] Actually, it is much more normal for members of different species to hunt, exploit and kill each other. Nonetheless, it is argued here that it is not *a priori* excluded that properties for the common good of systems of several species or even of ecosystems could exist.[1046]

Ecosystems are dynamic complex systems almost defined by the interaction effects of their compounding different species, organisms and abiotic environments. As we are here still concerned with replicators only, one may rephrase this concept as a synergetic ecological interaction of several reproductively isolated gene-pools with their environment (➲ the following critique of germ-line-reductionism, pp. 311 f.). In either case ecosystems appear to be partly self-regulatory with frequent negative feedback loops, giving rise to new synergetic properties. (On the relevance of self-referential causation, ➲ pp. 409 f.).

[1045] St. J. Gould, *The Structure of Evolutionary Theory* (2005), p. 612.

[1046] J. Lovelock has even radically advocated that the Earth as a whole should be regarded as one organism, *Gaia* (1979); *The Ages of Gaia* (1988).

The predator-prey relationship, as a simple two species system described by the Volterra-Lotka equations[1047], exhibits neither exponential growth, nor linear stability, as usual patterns to describe single populations, but an oscillation of the population size of the two species with a phase lag. Although this oscillation could be regarded as a synergetic property, it is not directly apparent that this relationship is for the good, neither of this higher system nor for the involved species. In a predator-prey relationship it appears that only the predator species profits from this interaction and will always exploit this system without constraints. But even such a system may lead also to the common good and may have self-stabilising properties.

First, restrains for the predator may evolve. If we imagine that in a predator species a larger mutation took place and that this species may 'win' the evolutionary race and capture all the existing prey, or so much that the prey species collapses. (We may likewise think of highly virulent bacteria killing almost all of its hosts.[1048]) In this case the winning of the evolutionary race could cause the extinction of the 'winner'. Actually such close prey-predator or parasite-host relationships are quite rare. But in any case the winning mutant will have a disadvantage and a geographically isolated group without this 'advantageous' mutation, may have a better chance to survive and may one day also reconquer this area. On the species level the predator which does not wipe out the prey population may become selected by group or species selection and the stability of this feature may also be secured by what I called systemic individual selection (➲ pp. 291 f.). But the real cause here would be the breakdown of an ecological system on which a predator depends; in a way we would be concerned with ecological selection for the good of that ecological system.

Secondly, if we assume that the prey would win the race, it appears that this would be only advantageous for the prey. But as long as the prey species is not completely wiped out by the predator it may, as mentioned before, profit from the resulting evolutionary race, because it may also become fitter in relation to other predators it may one day encounter. Additionally, this victory also in part due to the effects on the larger ecological system might turn out to be a Pyrrhic victory. For example the possibly exponentially growing population may disrupt the balance of the ecosystem on which the species relies.

> Besides maintaining a moderate population size, predators (and generally consumer species), have also other ecological positive 'functions', necessary for the stability of an ecological system. For instance, the consumer species in the fragile ecosystem of the tundra are probably necessarily for breaking down the dead plant matter. In the tundra the decomposers are not abundant enough to break down all the dead plant matter of the producers directly, to provide the nutrients and soil for the plants.

Hence, even in the case of predator-prey relations something like ecological selection for the good of an ecological system may under certain preconditions take place.

[1047] Lotka and Volterra took a systemic approach to evolution, albeit accepting natural selection and arguing for a more harmonious understanding of ecosystems than the ascendent Darwinism of the 1930s.

[1048] On the group selection of low-virulence strains, cf. E. Sober, D. S. Wilson, *Onto Others* (1998), pp. 48-49.

Nevertheless the probability of a subversion of such system is still high, since for example the predator may wipe out a prey species and if the disadvantage is not too high feed on another species.

We now consider the less problematic example of a synergetic system of species which more directly serves the involved species. In such cases of symbiosis (mutualism) the interaction of species has a direct positive fitness effect for all involved species. Following my general approach, it would be absurd to argue that these systems do not exist, because they are obviously more than the sum of their parts.[1049]

Lichens, for example, are composite plants consisting of a fungus and one or more algae. The involved kinds of organisms are different in kind, but form a common body. The alga synthesises carbohydrate that is taken up as food by the fungus, the fungus provides a structure that protects the alga from dry and other harsh conditions. Some lichens have metabolic products which each of its composing forms does not produce themselves. Because of the symbiotic and hence synergetic advantageous properties of this system, lichens are able to live as pioneers for example on rocks, in deserts or in alpine regions. There are several examples of such mutualist relationships (e.g., the termite and its methanogenic gut biota, or the polyp-zooxanthella association) and it is interesting that there are approximately ten times as many bacterial cells in the human flora (build of bacteria and fungi) as there are human cells in the body.

But, returning to the main issue, a synergetic advantageous property of a system which could be selected, is, as we have seen, not enough for a synergetic whole to be evolutionarily stable. Additionally it has to be shown that a synergetic ecological system could prevent its subversion by an egoistic species. Again we may think of a 'cheating' species, which profits from the system, but does not contribute enough to sustain the system and thus undermines the surplus fitness of the system. In our example of lichens a hypothetical mutant alga may produce not enough carbohydrate for the fungus and instead replicate within the lichen independent from the fungus. Those egoistic algae would undermine the symbiotic system, but would internally have an advantage relative to other algae. But the symbiotic system in which such a subversion would have taken place, would have had a much reduced probability to multiply as a whole. This is quite analogous with group selection of whole groups. Those groups which as a whole are less advantageous may become extinct. Although from the viewpoint of the single organism we are concerned with something like group or species selection the ultimate relevant property here, however, exists on the level of the ecosystem. Hence, this is an example of a synergetic property of a system of organisms of different species which is not easily subverted by selfish mutants.

Although this is an example at odds with a view that there are no ecological properties with evolutionary relevance in their own right, lichens are based on a particular form of symbiosis, which pervades almost all aspect of the life of the species involved and where even the reproduction of the two species is usually linked to each other (only the involved alga can under some conditions reproduce independently). The symbiotic system of these organisms has caused or is partly itself

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[1049] On the problem of a tautological definition of wholes as parts, ➲ pp. 277 f.

a selection system where normally ecological selection, via something like group selection, outweighs individual selection. The common reproduction of these different organisms guarantees that their synergetic properties are tested together in the next generation. Here the common reproduction in a way serves as the geographical isolation of different groups.

That such stable symbiotic communities are not necessarily undermined by selfish mutants, also becomes apparent in regard of ourselves, as we, like all other multicellular organisms, are build out of complex, eukaryotic cells. According to L. Margulis hypothesis of endosymbiosis, the eukaryotic cell resulted from the association of various single celled species. Today these species – actually constituting us – form a permanent symbiosis obligatory for their, and our, survival. In this sense each of us humans *is* a symbiotic system.

A strict link between the reproduction of two species (which still do not interbreed) appears to be a very successful strategy to secure a close and intimate symbiosis against subversion. It could also in a way be found, for example, in ants which tend and protect aphids and periodically 'milk' them. Although here the aphids could reproduce independently and the reproductive link is less close in some ant species, some aphids are taken with the queen when founding a new colony. But neither a strict nor a less strict reproductive link appears to be a necessary precondition for a stable symbiosis.

In analogy, ecological selection can not only work like the inner-specific selection of whole groups, but also like group selection in structured populations, where the individual animals are not strictly bound to a group but mix again to form new groups. Concerning systems of species, a certain isolation or particular close interaction of the involved species also appears normally to be given, if this symbiosis should be evolutionarily stable. This common isolation and interaction of subpopulations of two species corresponds to what inner-specifically in respect of individuals is called a 'group'. But the common functional and geographical isolation and interaction of the sub-populations of both species need not be a strict one as in the example of lichen above. A link of the subpopulations of the species limited in time or in amount (in analogy one can think of a semi-isolation of groups) could obviously be sufficient to stabilise a symbiosis. For example, there are ant species where new colonies usually take new aphids. These sub-populations of two species are, for the time the colony exists, linked to each other. For this time they are in a way commonly isolated and dependent on each other, although their reproduction is not closely linked in the sense that the ants species also keeps the aphids in new colonies. But the link between the subpopulations of these species is close enough that ecological selection may act on this system and that a subversion becomes prevented.

But symbiotic relations also appear to exist if the relation of the involved species is weaker, particularly in relationships where many species are involved. Up until here we were mainly concerned with two-species relationships, but ecosystems are vastly more complex. The interactions in these systems are only beginning to be appreciated, but I think, although this can not be shown in detail here, that also some properties of a larger system are for the good of such systems and have been object of ecological selection. Different species are linked in complex food chains and food webs.

Likewise, in regard to shelter and other aspects of life they are often mutually dependent, not necessary only in a one-to-one relationship.

A more complex, but also quite clearly symbiotic, interaction is the coevolution for example between flowers and pollinators or similarly between fruit-bearing plants and birds or apes etc. Many flowers have nectaries to provide nectar which serves as food for butterflies and many other insects, which in turn pollinate them. The successfulness of the involved species relies on this symbiotic system they constitute. But for many-species systems the problem of a subversion is particularly obvious. Cases of subversive 'cheating' actually do exist, there are for example flowers, which imitate normal flowers with nectaries, but which actually do not 'invest' in producing nectaries. They do not support the synergetic symbiotic system, but still profit from it by being pollinated. There are also insects which the other way round make use of nectaries without pollinating the flowers which provide the nectar. But obviously this cheating is not so abundant, since such symbiotic systems obviously still do exist. Some insects even actively, with no direct advantage (but presumably with an indirect ecological one), help in pollinating flowers. Here a kind of ecological selection appears to play a role securing that the mutual advantages of this system are not subverted. This would be rather analogous to group selection in structured population, because the involved species are not reproductively linked. How such complex ecological systems are stabilised against subversion is only beginning to be understood by evolutionary ecology (mosaic evolution etc.).[1050]

The even much more complex interdependence of different species in an ecosystem becomes particularly apparent by the succession of different relatively coherent communities of plants and animals in areas which are either colonised by life for the first time, like the bare rock of a volcanic island, or which have been devastated, for example, by a forest fire. In the beginning of a succession only a few species constitute this system. The system is very fragile and the energy flux through the system is quick. Although the first species will soon be replaced they are normally the only species which can gain ground under these harsh conditions. As the succession proceeds the simple old communities are replaced again and again by characteristic new other ones, which are often more complex, often stratified, and enable more species to coexist with one another. If one is concerned with a resettlement of a devastated region by already existing species, the succession will cumulate in a constellation of an equilibrium, by ecologists called 'climax', where further changes usually take place only slowly. At this point the ecosystem, despite fluctuations, is stable and invading species largely fail to gain a foothold. Likewise if these species are able to enter this ecological system or if environmental conditions fluctuate, the increased richness of species and the complexity of relationships normally buffer the ecological system. The biomass, the number of species and individuals and the complexity of their relationships has increased. The energy flux has slowed down. The degree of organisation is sometimes expressed by the informational content and the entropy of a system, by the quotient of biomass (stored

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[1050] Confer also my defence of the evolutionary relevance of phenotypes, based on inter-specific interactions, ➲ pp. 326 f.

energy, *enthalpy*) and the used energy (*entropy*). One may dispute this as a simplistic understanding of organisation, but in any case it is striking that this systemic property, which also if measured in such a simplistic way appears to increase in such successions.

One may argue that the involved species during an ecological succession create an environment for each other. It is not denied that competition plays a crucial role in this development and that ecosystems may be subverted by egoistic species and may collapse. However, I oppose a mere reformulation of ecological phenomena in terms of single species or even single genes and their environments. This would be inappropriate, since this would neglect the supersummative aspects of the evolution of ecosystems and dependencies involved.

Often the importance of inter-specific interactions unfortunately only becomes apparent after a system has become disrupted. The building of highly organised ecosystems in evolutionary terms also is assumed to need a long time, many millions of years, but their destruction can proceed much quicker. Although extinctions of species are something normal in evolution, we for example currently live in a period of mass extinction. Despite being caused by human activity, the concealed danger of the ecological problems lies in an inner dynamics based, for example, on the breakdown of food chains. We also experience the instability of the remaining fragile ecological systems if non-endemic organisms are introduced into a system or if pests could easily destabilise an ecological system. The current ecological crisis also leads to an abiotic problem, like the depletion and erosion of soil, or, since less water becomes stored in plants, flood disasters and catastrophic draughts.

Palaeontologically, the beginning and end of the Mesozoic era, the 'age of the reptiles', is marked by the world's largest mass extinctions. Besides external causes a dynamics of a collapsing ecosystem should also be considered.

The difference between species and ecosystems remains apparent and the problem of subversion appears to be more pressing in the ecological case. Of course, not everything which a species does is necessarily positive for its ecosystem. Our own species gives an excellent example of this possibility. But if a species tends radically to destroy its ecosystem, it will not survive for long. A first step to prevent so-called *Homo sapiens sapiens* sharing such a destiny, seems to me, to stop denying the existence of ecosystems.

The main results of the sections on the transcendence of gene-atomism can be summed up as follows:

(1) It has been shown that gene-Darwinian gene-atomism is not defined to be true by definition. Single genes, which are claimed to be the units of selection, are not defined as any stretch of DNA. Despite some echoes of such a tautological approach to the unit of selection debate, it is apparent that gene-Darwinians argue that in sexually reproducing organisms short and selfish stretches of DNA are the only units of selection.

(2) The general concept of higher genetic units is introduced and it is shown that the meiotic shuffle in sexually reproducing organisms does not prevent the existence of higher genetic units. Corresponding to my critique of the physicalist research

program (➲ pp. 245 f.), I advocate that genetic wholes with synergetic properties can be regarded to exist particularly in their own right.

(3) Probabilistic higher-level genes have a top down effect on single genes. This downward selection or downward sorting is presumably the simplest kind of downward causation. But higher-level genes even *within* individuals need not become established by individual selection. High-level genes still may be subverted by selfish genes not serving the individual good. But, provided certain frequency distributions in the population, these high-level genes not only have an evolutionary effect, but they could become evolutionarily stable against subversion.

(4) I discuss the fallacy claiming gene-atomism tautologically. Here wholes are excluded from the semantic framework, because wholes are simply redefined in terms of their parts. This is different from the first point, where such a tautology is given by the definition of a gene as a stretch of DNA of any length. Now larger wholes are not simple redefined to be called single genes as well, but wholes are defined in terms of their *several* composing single genes, with no regard whether the wholes are more than the sum of their parts or not and with no regard to whether these synergetic properties cause their own stability or not. This is linked to the claim that those genes which have survived are the fittest. This is true since fitness is defined by survival. This tautological view could even be applied to cases of radical group selection. Even there, of course, the genes are the fittest that have survived. This is true but does not contribute anything to the question of whether wholes can determine the course of evolution. This tautological defence of gene-atomism has never been seriously proposed by gene-Darwinians, but implicitly it may well have played a role in immunising gene-atomism against any critique.

(5) Higher-level properties in different organisms of a species are discussed. I describe four ways in which the good for the group may be achieved. In my view the proposed concept of systemic individual selection, transcending mere individual selection, is of particular interest. Systemic individual selection, based on an interaction of alleles at different loci could lead to a stabilisation of traits which are not favourable on their own. If once combined with group selection, this process may stabilise properties for the good of the group without the need of further group selection. In regard to group selection itself, I largely only follow the model of Sober and D. S. Wilson, but propose an extension of the applicability of their model to all groups which mix with the main population, if they are small enough to lead to the required group variance.

(6) The concept of species selection is discussed, which becomes particularly interesting in combination with the proposed process of systemic individual selection. Moreover, I have outlined that predator-prey relationships, symbiotic relationships and more complex ecological relationships could have a synergetic effect and their own stability. It appears possible that properties for the good of a larger ecological system may exist, which have been favoured by something like 'ecological selection'.

In conclusion, it generally appears to be wrong that – as gene-atomism suggests – an adaptation is never 'for the good' of a larger genetic wholes, but only for the good of selfish genes. Still, of course, we have not concluded that adaptations are *only* for the good of higher units and *never* for the good of selfish single genes. Based on the refutation of strict gene-atomism and based on the supported view of higher ontological levels of existence, likewise William's (1960) methodological assumption that the burden of proof should always rest on the higher levels of explanation, is called into question. It appears more balanced that the burden of proof should rest equally at all different levels.

Even if we adopted the 'principle of egoism' in regard to substances and accept the classical dichotomy of substance and accident, genes have to a certain extent to be seen not as substances but to some extent as accidents of higher wholes. The survival of the whole is not only determined by its parts but the survival of the parts is to some extent also determined by the whole. In regard to Dawkins' concept of selfish genes, both the exclusive existence and the ruthless 'selfishness' of single genes have in their radicalness been shown to be wrong.

8.3 Genetic Reductionism II: Germ-Line Reductionism and Its Transcendence

a) Germ-Line Reductionism – The Strong Interpretation of the Weismann Barrier

The second form of genetic reductionism of gene-Darwinism, which is even accepted by some of its critics, is germ-line reductionism. This is a strong interpretation of the so-called *central dogma of microbiology*, the modern version of the Weismannian theory of the continuity of the germ plasm. Germ-line reductionism emphasises that there are *only* causal arrows leading from genes to body, but none "leading from body to genes."[1051]

If we replace 'gene' with 'eidos'/idea, this, paradoxically, becomes reminiscent of a Platonic view. Genes are regarded as being somehow eternal, like ideas in the Platonic *mundus intelligibilis* they are the true underlying background of the actual, changing *mundus sensibilis*.[1052] (Of course, neither Plato nor the modern germ-line reductionists would be happy about this parallel, because – as we have seen above – both employ opposed concepts of substance, the former focusing on form, the latter on matter. ➲ pp. 248 f.) Although germ-line reductionists obviously do not regard vehicles as *completely* negligible (just as a Platonist would not *completely* ignore the actual world), to them the germ-line is the primary, approximately eternal, biological substance. Vehicles, like individuals or groups, according to germ-line reductionism, are less real, unstable and temporary "like clouds in the sky or dust-storms in the desert."[1053]

> The view radicalises the general tendency of neo-Darwinism stressing that the developed exists for the undeveloped, the tree exists for the germ, and thereby opposes earlier traditional approaches.[1054]

Weismann (➲ pp. 118 f.) stated that the germ plasm is never modified by the somato plasm. The modernised version of this view, the so-called *central dogma of microbiology*

[1051] R. Dawkins, *The Extended Gene* (1982/1989), p. 97, see p. 98.

[1052] ➲ p. 71.

[1053] R. Dawkins, *The Selfish Gene* (1976/1989), p. 34; *The Extended Phenotype* (1982/1989), p. 99.

[1054] H. Jonas, *Organismus und Freiheit* (1966/1974/1994), p. 94.

(cf. J. Watson, 1952), states that the genotype, the DNA, is never modified by the phenotype (Figure 8).

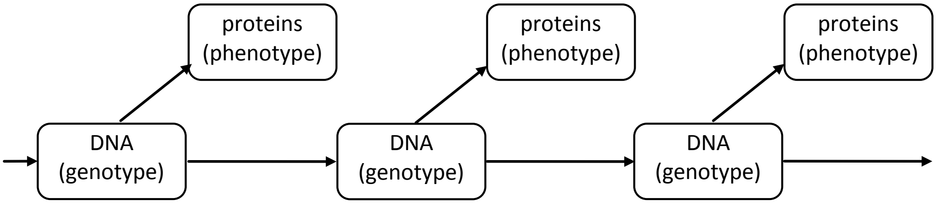

Figure 8: Flux of information according to the 'central dogma of microbiology'—an updated version of Weismann's *Keimplasmatheorie.*

This modernised Weismannian view, bound to the theory of random mutation and external selection, is the backbone of all neo-Darwinian paradigms. Since the end of the eclipse of Darwinism, this Weismannian theory has successfully refuted alternative Lamarckian approaches (e. g. T. D. Lysenko), and today it is a theory which is very widely held.

I would agree that much evidence speaks in favour of this modernised Weismannism with its implications for our understanding of evolution, but I think one should also acknowledge the following three points in order to reach a balanced position. Firstly, even Darwinian subparadigms differ a lot in their interpretations of the Darwinain or Weismannian central dogma. The central dogma itself does not appear to entail germ-line reductionism. Secondly, even the central dogma has recently been challenged by a heterodox group of biologists and may become modified in the course of the molecular revolution. Thirdly, even if one accepts the basic Weismannian doctrine as a currently valid hypothesis, as I do, it does not give a complete account of the interaction between genotype and phenotype.

(i) Different Interpretations of the Central Dogma

The acceptance of the central dogma of microbiology does not necessarily entail germ-line reductionism. The central dogma is presupposed by germ-line reductionism. It is a necessary but not a sufficient condition for germ-line reductionism. Germ-line reductionism is a particularly strong interpretation of this dogma, which regards the genotypic side of evolution as being substantial and real, whereas the phenotypic side is regarded as only providing the temporary and less real vehicles for the genes. Dawkins advocates a clear and radical germ-line reductionism according to which interactors are mere 'vehicles', 'gene-machines' or 'survival machines of the genes'.[1055]

[1055] R. Dawkins, *The Selfish Gene* (1976/1989); *The Extended Phenotype* (1982/1989), ➲ footnotes 561, 875.

In principle Dawkins even goes further. "Fundamentally, all that we have a right to expect from our theory is a battleground of replicators".[1056]

This approach radicalises the general tendency of Darwinism that organisms are understood as being the object of and not subject to evolution. According to this approach organisms are not only externally moulded by natural selection but internally determined by genes, which in turn are determined by natural selection.[1057] Gene-Darwinism, of course, accepts statistical fluctuations in the phenotypic expression of the genotype, but the organism is, nevertheless, seen as a mere vehicle, which does not contribute anything to evolution that has not already been given by the single genes.

Proponents of the evolutionary synthesis have differed from the strict gene-Darwinian interpretation of the central dogma, which is also vital for their also largely Darwinian theory (➲ pp. 123 f.). Proponents particularly of the second phase of the synthesis do not support and partly explicitly oppose strict germ-line reductionism. They advocate that the phenotype plays a crucial role in selection. Notably E. Mayr has emphasised the role of the phenotypic organism.[1058] But proponents of the second step of the synthesis generally also emphasised phenotypic properties at the level of populations, especially if the population structure of a species is phenotypically changed by geographic isolation (➲ pp. 127 f.). Nevertheless some aspects of the evolutionary synthesis particularly in its first phase of 'bean-bag genetics', also prepared today's germ-line reductionism (➲ p. 193). However, in its second phase the synthesis can not be said to have advocated a full-blown form of germ-line reductionism.

The importance of the phenotype is even more strongly emphasised by explicit critics of radical Darwinism (➲ pp. 92 f., p. 101.), who have reintroduced concepts of romantic biology to evolutionary theory. Despite many differences they all emphasise that evolution is not only determined by genes, but is also constrained and directed by morphology, body plans or morphological fields.[1059] (Often this tradition only has focused on structural necessities, but, I think, in principle the idea of phenotypic constraints can and has to be extended to functional constraints as well.[1060]) Although proponents of such an approach may accept the Weismannian central dogma, they may still emphasise that interactors may also play their own cardinal role in evolution and are not mere 'vehicles' or 'survival machines of the genes'.

(ii) Violations of the Weismannian Dogma?

Despite the considerable differences in the interpretation of the Weismannian dogma, all approaches would regard something like the systematic appearance of reverse transcription of RNA to DNA in germ cells as being rather contrary to the

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[1056] *Idem*, *The Selfish Gene* (1989), p. 256, see p. 266.

[1057] Cf.: K. Bayertz, *Autonomie und Biologie* (1993), p. 346.

[1058] E.g., E. Mayr, *The Growth of Biological Thought* (1982), p. 588.

[1059] E.g., G. Webster, B. Goodwin, *Form and Transformation: Generative and Relational Principles in Biology* (1996).

[1060] Cf.: J. W. Bock, G. v. Wahlert, *Adaptation and the Form-Function Complex* (1965/1998), pp. 119-120.

Weismannian dogma and also to its radicalization, the germ-line reductionist 'neo-Weismannian' dogma.

Despite earlier refutations of a radical Lamarckism, some more recent findings in molecular biology render a more moderate comeback of such a view to be not totally implausible. Actually, the existence of reverse transcription was first observed in the late 1950s. It was fully confirmed in 1970 for retroviruses (H. Temin, D. Baltimore were awarded the Nobel Prize for their findings in 1975). Now many retroviruses are known to infect mammals or birds; HIV belongs to this class. Although this in a subtle way challenges the central dogma, retroviruses are, of course, not processes in healthy organisms.

However, the general molecular revolution, and the modelling of complex systems, has increasingly unsettled the assumption of a totally stable organismic genome, which only becomes changed randomly during meiosis (➲ p. 148). We now know that DNA is capable of repairing itself. Generally, the Nobel laureate B. McClintock has shown that genes can be moved within or between chromosomes. If now the cellular 'milieu' had a systematic influence on such gene transpositions, especially in the germ cells, this would definitely violate the Weismannian central dogma.[1061]

> Also in regard of mutational change germ-line reductionism may become violated by further research. It is acknowledged that some chemicals cause mutation which are located specifically in certain chromosomal areas.[1062] If an organism under certain circumstances would produce such mutagenic substances itself, this might once be interpreted as a systematic violation of the Weismannian doctrine.

One may paradoxically argue that Darwinian adaptationists should in principle predict that Lamarckian mechanisms have evolved.

> The non-existence of such a Lamarckian mechanism would also point to the limits of adaptationism. An interesting objection to such an argument would be that the Weismann barrier may also have an adaptive advantage. It may, for example, serve as a defence against viruses or it may secure equal reproductive chances of the genes, rendering the organism as a whole more stable.

Since the late 1970s Ted Steel has been proposing and developing a Lamarckian theory of the immuno system of higher animals based on somatic mutation and selection and the reverse transcription of the aquired properties to the DNA. Although some of his results have been disputed, he and his school in recent years appear to have come closer to a full confirmation of their theory.[1063] If his theory

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[1061] Not all organisms have specialised germ cells. In many plants or fungi the variation of somatic cells can be inherited. From the viewpoint of the organism this violates the Weismannian dogma. L. W. Buss, *Evolution, Development, and the Units of Selection* (1983), quoted in E. Lloyd., *The Structure and Confirmation of Evolutionary Theory* (1988/1994), pp. 66-67. Although this indeed violates the classical Weismannian theory, it does in my opinion not equally violate its modern formulation and its radical germ-line reductionist interpretation. Modern germ-line reductionists do not accept organisms as real entities anyway and to them the germ line is not defined by certain cells but by DNA.

[1062] See e.g., R. Fahrig (Ed.), *Mutationsforschung und genetische Toxikologie* (1993), pp. 6, 50.

[1063] E. J. Steele, R. A. Lindley, R. V. Blanden, *Lamarck's Signature* (1998). ➲ p. 148.

became accepted, a moderate explicitly Lamarckian perspective in genetics would gain ground.

> Generally, I think, the self-organisation of the genome is still underestimated. Firstly, most research is still limited to very simple organisms, like viruses or the genome of fruit flies. Secondly, the evolutionary synthesis had reached a discursive equilibrium, allowing both pluralism and group properties. Despite their comparatively moderate interpretation of the Weismannian view, it assumed a simple relationship between genotype and phenotype as an artefact of their Mendelian methodology[1064].

Research which stresses the self-organisation of the DNA, even under somatic influences, may be promising, but it can not be evaluated here in how far particular Steel's approach is empirically supported and whether, in the case of its confirmation, it is applicable to other phenomena besides the immune systems of higher animals.

I shall hence not rest my argumentation on the validity of this empirical claim. Moreover, an enhanced interpretation of acknowledged facts, in my opinion, refutes the radical germ-line reductionist interpretation of the central dogma, and defends the evolutionary relevance of phenotypes in their own right.[1065]

(iii) The Central Dogma as Only Partial Description of the Relationships between Genotype and Phenotype

In the first point above we have distinguished the central dogma and its radical germ-line reductionist interpretation. Here and in the following sections I argue that the central dogma is not an exhaustive account of the genotype-phenotype interaction, as claimed by gene-Darwinians.

The central dogma merely states that the DNA could not be physically altered by the phenotype (of that organism). More radically, germ-line reductionism claims that "there is no causal arrow leading from the body to genes"➲[1051] and hence "organisms are but the transient engines of long-term gene replication."[1066] Germ-line reductionism argues that there is no flux of information from the phenotype to the genotype and no autonomous role of the phenotypes in evolution. Phenotypes are regarded as mere vehicles which are in principle reducible to single selfish genes and which are ultimately the only agents of evolution.

We have seen that there have been biologists who accepted the central dogma, but have still advocated the relevance of phenotypes in their own right. In the next sections I propose a justification for such a view which is at odds with strict germ-line reductionism.

I argue that not only the information of the genotype but also what I call 'exformation' influences the phenotype. I do not deny the existence of genes, but

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[1064] Cf.: R. Lewontin, *Gene, Organism, Environment* (1983/1985).

[1065] In any case I do not think that a *purely* Lamarckian view is in sight. If, for example, you start regularly to sunbathe or you went regularly to a solarium, your baby will presumably not be born with a darker skin colour than you have. But instead of seeing Lamarckism and Darwinism as a dichotomy, I shall argue that it is more appropriate to see them as extremes of a spectrum of theoretical options, which may even be valid in different respects (➲ pp. 359 f.).

[1066] R. Dawkins, *Replicator Selection and the Extended Phenotype* (1978), p. 68

argue that the phenotype based on exformational aspects is full of ‘stuffness’➲[1074] as well. A reduction to the gene level in this view is a false simplification. The phenotype even determines what parts of the genetic code are read and how this code is interpreted, otherwise the cells with identical genes in different tissues would not behave completely differently. Moreover, the phenotype itself constrains and directs its possible evolutionary pathways. It will be argued that phenotypes themselves are evolutionary factors. I shall finally expose a somewhat more daring proposal of how mutual morphological resonance of co-evolving species may be evolutionarily relevant. For this argument the concept of form is replaced by the concept of a probabilistic morphological field.

Hence, the ‘central dogma’ in the next sections will be shown not to be an exhaustive theory of genotype-phenotype relations and, thus, germ-line reductionism, as found in gene-Darwinism, is rejected.

b) Information, Exformation and Phenotype as Evolutionary Factors

(i) The General Concept of Exformation

The concept proposed here of exformation can not only be applied to biology, but is intended as more general. It arises out of the critique of the modern materialistic concept of substance and epistemological downward reductionism above. Ontologically, it has been argued that it is not reasonable to reduce all wholes to their parts. Epistemologically, it has been shown that it is not reasonable to favour downward reductionism as the only type of explanation (➲ pp. 248 f.).

Somewhat analogous to the proposed types of explanation (➲ p. 254) an entity, according to this view, is itself understood as a form or a system, determined not only by its elements but also by the (irreducible) relations between its elements (form in the narrow sense).[1067] For the ‘formation’ of an entity, it is not only its in-formational aspects but also *ex*-formational ones which are important. The elements and the relations between the elements are additionally co-constituted by an ‘external’ environment. Only those elements of the external world are relevant which are related to that entity (Uexküllian understanding of environment). The entities themselves will normally only be stable under certain external conditions. For instance atoms have not always been stable throughout the history of the universe. Also the relations of the elements are exformationally influenced; we may, for instance, think of a whirl in a wash-basin (➲ p. 254), where the direction of relative movements of the involved water molecules, the direction of the ‘Coriolis force’, is ultimately determined by the rotation of the whole earth. Neglecting these exformational explanations by restricting

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[1067] Aristotelian hylemorphism may also help us to reach more appropriate results in the mind-body problem as well. M. McGinn, *Real Things and the Mind Body Problem* (1999, unpubl.). It has even been argued recently that there “is nothing absurd in the notion of form without matter”. J. Lowe, *Form Without Matter* (1999).

oneself to only proximate[1068] downward reductionist explanation of a whole by its parts, seemed epistemologically and ontologically inadequate to me.

The concept of exformation becomes particularly apparent in respect to computer programs. The in-formation in a certain application program is always only interpretable if it is interpretable by the ex-formational operating system. Together they build, so to speak, a formational whole. Many functions of a certain application program refer to externally defined functions of a larger system. Likewise while the text file I am currently working with contains information, it only becomes readable when a certain exformational program which can interpret this file interacts with it.

Yet in this view how should entities be treated which have no further parts but are in themselves final elements? The only physical entities which may have this character are the elementary particles in physics. To sustain the proposed position one could simply concede that these are the only entities where there is no need to refer to exformation since they exist in an unchanged way, independent of any inner relation and any outer conditions. Although not a physicist, I tend to interpret these entities differently in terms of exformation. Quarks and antiquarks only emerge and disappear in couples; the so-called baryon number is always preserved.[1069] Thus a kind of context dependence, reminding one of positive or negative electrical charges, apparently exists here as well.

In respect to human memory it is not difficult to find examples of exformation: we only have to think of a knot in one's handkerchief or of a digital personal assistant. But exformation also plays a role in less obvious cases. Let us think of the activity of tying one's shoe-laces. Some aspects of this activity are obviously stored in our memory itself (information). But although we are capable of tying our shoe laces, we might not easily be able to carry out the exact movement without holding the actual laces in our hands. Exformation lies in the laces themselves and in the specific interaction of the laces while one is tying them. Exformation is most intimately linked with information. Exformation in respect to our own memory is also often present when we are not aware of it, for example, in the way we structure our rooms or we organise our desks etc. The external is not always really external but rather a part of us.

Although the concept of exformation, and more specifically also that of external 'memory', is in my view applicable to many areas, it will in the following sections only be developed in a biological respect, in contrast to biological germ-line reductionism.

(ii) Exformation and the Stuffness of the Phenotype

The phenotype, and also the extended phenotype, is not only a result of genomic information but of exformation as well. In the section on gene-atomism I have argued that together genes may form synergetic wholes with a higher fitness than each individual part (➲ pp. 264 f.). Also their synergetic properties can only be understood

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[1068] The terms 'ultimate' and 'proximate' are used here in a similar but different way from their usual sense in the evolutionary discourse.

[1069] Such a 'contextual' concept of preservation is also advocated in regard to the lepton numbers L^e, L^μ, L^τ of the three lepton families. See e.g., K Stierstadt, *Physik der Materie* (1989), pp. 19 f.

if the phenotypes are considered. In this sub-section another context argument is proposed now for information *and* exformation.

In this view 'external' environments of genes are not only mere accidental surroundings of these entities but also essential parts of their being. Lewontin, for instance, has stressed that genetic and environmental causes are "inseparable"[1070]. Nevertheless, I think that it is still possible to argue, for example, that the atomic structure of a hydrocarbon molecule itself is not coded into the genes. Although they make use of this structure, the structure is stored externally to the DNA. Likewise, the synergetic larger physical and chemical properties of a cell and of organs are neither completely stored in the genes. There is an exformational side as well and a morphological logic caused by the information-exformation interaction. From the viewpoint of the genetic informational side, exformational aspects simply appear as given, but they are nevertheless aspects of reality in their own right, essential for the genes and not themselves stored within the genes. Hence the phenotype is not only based on information, but on exformation as well.

This argument appears to be linked to the argument that only the phenotype is visible to selection, whereas the genes or the genotype are not. This argument has, for example, been elaborated in a more formal way by R. Brandon, who makes use of the statistical concept of '*screening of*'. He argues that the phenotype and not the genotype determines and directly explains the fitness of an organism or a group. For example, the phenotypic property of the height of a tree may determine their fitness. Selection only 'sees' the phenotype irrespectively of the genotype.[1071]

This claim, in my view, implicitly refers to two reasons why this may be the case. Firstly, the phenotype, as outlined above, is not determined by the genotype alone, but by exformation as well. A genotype alone does not determine the properties and fitness of a phenotype but exformational aspects like the soil in which the tree grows could equally change the 'seen' fitness. Secondly, given constant exformation, different combinations of genes may also lead to the same phenotype. If height is an advantageous property, then a certain gene is not favoured but possibly quite different combinations of genes. This refers to the contextuality within the genotypic side itself and is treated in detail in section 8.2 (➲ pp. 264 f.). In any case the interaction of genes occurs on the phenotypic side, which is entangled with exformation.

Although Brandon is right in some respects, I partly agree with his critics Sterelny and Kitcher, who argue that one can indirectly still speak of genes being selected, if one takes all the different environments into account and abstracts from them.[1072] I think they are right as far as they claim that one can investigate in which genetic and exformational environments certain genes are fit in. But in my view this does not imply that single genes are the only units of selection. (I have treated earlier larger units of the informational side of evolution ➲ pp. 264 f.) and does not at all entail that phenotypes are epiphenomenal, a point which is more important for our present concern.

[1070] R. Lewontin, *Gene, Organism, Environment* (1983/1985).

[1071] R. N. Brandon, *The Levels of Selection: A Hierarchy of Interactors* (1988/1998), pp. 180 f.

[1072] K. Sterelny, P. Kitcher, *The Return of the Gene* (1988/1998), pp. 165 f.

On the contrary, phenotypes are ontologically and epistemologically prior to genotypes. Brandon is, in my opinion, completely right in arguing that only the phenotype could directly be seen by natural selection. We, and in a way natural selection, can finally calculate the advantages and disadvantages of single genes, but this is always abstracted from properties phenotypes have, which are in turn not only dependent on genetic information but on exformation as well. Evolution selects certain phenotypic properties, which are the result of certain information-exformation interaction. Only based on the very existence of phenotypic properties, can we speak of a gene for such a property. Of course, today's geneticists have a direct acquaintance with DNA, but they also still need phenotypes to interpret a sequence of DNA as being a gene for something. The sequencing of the genome in the human genome project only reveals the informational code, an understanding of the meaning of the code, will only be acquired if the phenotypic interaction of the parts of this code and their interaction with exformation is understood.[1073] I do not deny the reality of genes, but I advocate the reality of phenotypes as well, which have properties not stored in the genes. Moreover, phenotypes are the very basis from which we and selection abstracts the meaning of genes. This gives us a first impression of why "anatomical or morphological structure is full of 'stuffness'." [1074] The phenotype is based on a synergetic interaction of *in*formation and *ex*formation. A view centred exclusively on *in*formation has to be rejected. It is not possible to reduce phenotypes completely to genic *in*formation.

(iii) Phenotype Interpreting Genotype

Although I have accepted the Weismannian central dogma, I think one does not need to accept the neo-Weismannian dogma that the phenotype needs not to be reducible to the informational side of evolution. I now argue that the phenotype, or indirectly also the outer exformation of genes, is crucial for the interpretation of the DNA itself (cf. Figure 9). It would be wrong to assume that in a phenotype the genetic information itself interacts in an unaltered way with exformation. It is more appropriate to argue that, although the physical DNA structure is not altered, the information content (its meaning) of the DNA itself is often changed by different exformational contexts. The 'semiotics of the genotype' is not context free and unambiguous.[1075] The last decades have revealed not only ways how genes control the phenotype, but also how genes are themselves controlled by the phenotype.[1076] The influence of the phenotypes and the cellular milieu on the interpretation of genotypes is apparent even without discussing specific experiments, if one conciders, for instance, the known different functioning of cells in different tissues, which all

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[1073] Cf.: H. Markl, *Von der Mediengesellschaft zur Wissensgesellschaft* (1997), p. 16.

[1074] P. Beurton, *Organismic Evolution and Subject-Object Dialectics* (1981), p. 49.

[1075] E. L. Khalil, *Neo-Classical Economics and Neo-Darwinism: Clearing the Way for Historical Thinking* (1992), p. 34. Contextualism, normally used in cultural epistemology has recently been advocated e. g. by Putnam and Derrida.

[1076] J. Bauer, *Prinzip Menschlichkeit* (2006), Chapter. 5. D. Nobel, *The Music of Life: Biology Beyond Genes* (2006), Chapter 7.

physically have the the same code of DNA. However, synchronically even single cells – like nerve cells, skin cells, and heart cells all differ in their organisation. Moreover, in developmental biology it becomes apparent that during the phases of ontogenesis – diachronically – different genetic sections of the identical cells may be decoded by the phenotype.

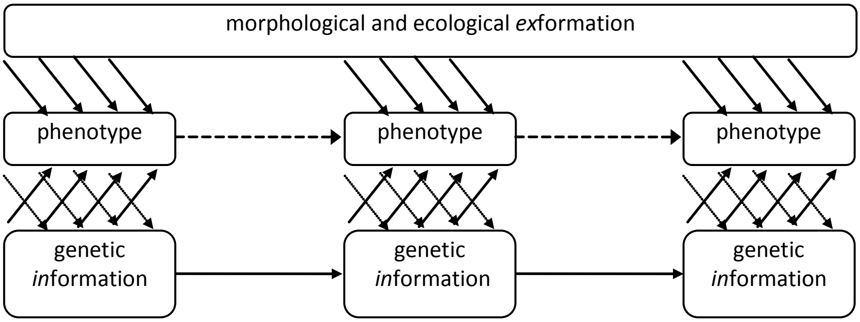

Figure 9: Flux of *formation*, including information and exformation, according to the points (1.) to (5.) of this section. The phenotype is not only determined by genic *in*formation, but by *ex*formation as well. Even if one accepts the central dogma of microbiology, the resulting phenotype has itself a certain influence on the genotype, interpreting the information and influencing what is transcribed (dotted arrows). Also the transfer of cytoplasm from phenotype to phenotype is indicated (dashed arrows). Moreover, not depicted here, the phenotype constrains and directs the viable evolutionary pathways (5.).

The importance of somatic and extra-somatic ex-formation was, for example, stressed earlier on by Driesch, who showed that during the early growth of a frog the cells of the frog's head could be transposed to its foot and vice versa. Their function at this stage solely depends on their position, i. e. their morphological and functional relation within the body.

Exformational aspects could even change the mode of reproduction. For example the Alpine Meadow Grass (*Poa alpina var. vivipara L.*) or some orchids reproduce either sexually or asexually depending on their environment.[1077] The informational side, of course, allows this possibility, but to ignore the importance of exformation in such an example is particularly absurd.

On the other hand the genotype likewise, in a Uexküllian sense, determines to a certain extent itself what exformational or environmental aspects become important. In turn the resulting somatic and extra-somatic exformation determines to a certain extent which aspects of the genome are read and how they are interpreted. Despite their differences information and exformation mutually determine each other dialectically. P. Beurton argued that "the evolutionary nature of genes is non-existent

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[1077] Personal communication with Simon Pierce (Univ. of Durham, Dept. of Biology, 1997).

outside the whole."[1078] I would not go that far, but, despite the existence of genes, I think it is true that biological information and exformation are concepts which are mutually dependent on each other. The information plays a role in interpreting the environment, as the exformation and the inner dynamics of the phenotype do in interpreting the DNA.

> The importance of exformation particularly becomes obvious in human culture as a special example of exformational memory (➲ pp. 324 f.). Medicine has mainly changed not the genetic makeup of humans, but has exformationally achieved the improvement of phenotypes. Particularly in a philosophical treatment of biology one should be aware that general biological concepts are often equally applied to humans as well. It would be wrong to conceal the evolutionary importance of exformation terminologically.

(iv) Stuffness and Inner Dynamics of the Phenotype

Stressing the information-exformation interaction one may still neglect the inner dynamics of phenotypic development. For example, Lewontin has turned against the view that organisms can be seen merely as effects with internal and external causes.[1079] He continues: "The fundamental general fact of phenogenetics is that the phenotype of organisms is a consequence of non-trivial interaction between genotype and environment during development. [...] The phenotype at any instant is not simply the consequence of its genotype and current environment, but also of its phenotype at the previous instant. That is, development is a first order Markov process in which the next step depends upon the present state. [...] Organisms as entities are one of the causes of their own development"[1080]

When cells divide and generate new cells, they transfer the information concerning their 'aquired pattern of gene expression' to daughter cells ('epigenetic inheritance').[1081] In contrast to purly genetic transfer of information in ontogenesis this is due to exformation; the process is either based on continuous signals from the body, or a kind of permanent molecular marking outside the DNA itself, determining which and how genes are expressed (genetic imprinting).

One may reasonably object that this might only be a plausible concept for ontogenesis, not for phylogenesis, since organisms die and only genes are transferred to the next generation. Indeed there are substantial differences between the processes of inheritance involved.

However, later I shall propose how phenotypic structures are not only exformationally influenced, but that in a limited sense properties can be inherited by morphological resonance (➲ pp. 324 f.).

Here I only want to point out that it is not correct to assume that the genotype at any time of reproduction is bare of any phenotypic context. Cytoplasm always embeds the nuclear genes even in the germ cells. A phenotypic context with which to interpret the DNA appears to be needed.

[1078] P. Beurton, *Organismic Evolution and Subject-Object Dialectics* (1981), p. 49.

[1079] R. Lewontin, *Gene, Organism, Environment* (1983/1985), p. 274.

[1080] *Ibid,* p. 277, 279.

[1081] D. Nobel, *The Music of Life: Biology Beyond Genes* (2006), Chapter 7.

More controversially, it has been argued, by M. W. Ho, that the cytoplasm also stores acquired characteristics of the phenotype, which may be transmitted to the next generation in this way.[1082] In any case, the continuous phenotype provides a necessary context for the interpretation of the genome, not reducible to genic information alone.

(v) Phenotype as Evolutionary Factor in Its Own Right

The phenotype is not only irreducible to the genotype because of its partly exformational basis and its inner dynamics, but can itself be regarded as an evolutionary factor in its own right.

Opponents of gene-Darwinism have often criticised the germ-line reductionist position which ignores the phenotypic morphology constraining or directing evolution. The concept of evolutionary constraints and inner direction is also historically rather opposed to Darwinism and is a hallmark of Platonic, Aristotelian, idealistic (*eidos* = form) or romantic biology, which claim a structural logic of development, rather in terms of form than in terms of matter (➲ pp. 92 f., 95 f.). Notwithstanding the triumph of Darwinism there has always been a more or less continuous, presently iconoclastic, research tradition of structurally orientated approaches in biology. H. Driesch, D'Arcy Thompson and C. H. Waddington are some of the main figures of this heterodox tradition. Today, the British biologist Goodwin, a disciple of Thompson, appears to be the most well known proponent of a morphologically orientated school of thought in the English speaking countries.[1083] But implicitly also proponents of the evolutionary synthesis, particularly Mayr (despite his critique of essentialism) may still have been somewhat influenced by this research tradition through their acceptance of a realist stance towards phenotypes. S. J. Gould, who is, modifications aside, largely a Darwinist, even more explicitly advocates the non-Darwinian concept of structural necessities and constraints.

Structural phenotypic necessities and resulting pathways in developmental biology have led Waddington to coin the metaphor of an epigenetic landscape. This notion has been applied to individual ontogeny and to phylogeny as well. Similarly, the concept of a body plan stressed phenotypic constraints. Arthropods (i. e. crabs, centipedes, spiders and insects) for example have exoskeletons, which protect them, but which are somewhat ineffective if the organism increases in size, since it needs to repeatedly burst out of its old skeleton. The body plan of an exoskeleton constrains the evolution of larger arthropods.

> The notion of a body plan need not necessary be understood in a Platonic way favouring only one ideal realisation but could also be understood in a rather Aristotelian sense, allowing variance, where the form, despite its own causal relevance is established by its parts. Later I shall for similar reasons replace the concept of forms by the concept of fields.[1084]

[1082] See: M.-W. Ho, P. T. Saunders (Eds.), *Beyond Neo-Darwinism: An Introduction to the New Evolutionary Paradigm* (1984). pp. 280 ff.

[1083] G. Webster, B. Goodwin, *Form and Transformation: Generative and Relational Principles in Biology* (1996).

[1084] ➲ pp. 324 f. (cf also footnote 1002)

The emphasis on forms, morphology and evolutionary constraints has been alien to Darwinism particularly because this aspect of the evolutionary process is not necessarily adaptive.[1085] Organismic constraints limit the number of possible pathways which selection may take. Hence not all aspects of evolutionary change are adaptive. Moreover, the traditional focus of Darwinism is on matter, not on form, and on a structural developmental logic. The focus is on the selection by an external environment and not on directions resulting from the inner phenotypic morphology.

Some gene-Darwinians have simply excluded such structural questions from the scientific agenda. They are just simply interested in adaptive phenomena. If one then claims the truth of pan-adaptionism one commits a tautological fallacy (➲ pp. 339 f.). Despite my critical attitude to radical Darwinism (➲ Chapter 9), I, like Gould, think that morphological approaches could be harmonised with a modified selectionist account.[1086] But since adaptation is closely entangled with structural aspects I agree with Lewontin that the metaphor of adaptation has to be generally replaced – or has at least to be complemented – by a metaphor of construction.[1087]

It is not only these phenotypes of organisms but also those of groups that are full of stuffness and can be regarded as evolutionary factors. Earlier I showed why gene-pools could develop properties which are good for the group and which are not necessarily subverted by selfish genes (➲ pp. 284 f.). These properties have been discussed on the genotypic side (gene-pools). Nevertheless, these properties, which are similar to the properties of individuals, can only be understood when based on an interaction of genetic information and exformation. This view would also rehabilitate the view of the evolutionary synthesis that the phenotypic structuredness of populations and the intensity of their geographical isolation are themselves evolutionary factors.

Phenotypes, organisms as well as groups etc. have to be taken seriously. They are full of stuffness, are not reducible to the genetic side and their constraints have an own evolutionary effect. The results of the last five sub-sections are partly visualised in Figure 9. The phenotype is not formed by genetic information alone, but by exformation as well. It is full of stuffness and can not be reduced to the germ-line. Despite accepting the Weismannian central dogma, the phenotype also plays an important role in regard to how the genotype is interpreted and which sections of the DNA-code are transcribed at all. Finally the phenotypic structure has its own causal relevance in constraining, enabling and facilitating certain evolutionary pathways. The phenotype is not only irreducible to the genotype but itself shapes evolution. Hence it is wrong to regard phenotypes merely as accidental vehicles or temporary epiphenomena without their own causal role, instead it is more appropriate to regard them as evolutionary factors in their own right.

[1085] A more differentiated account on different relations of constraints and adaptation is given by: R. Amundson, *Two Concepts of Constraint: Adaptationism and the Challenge from Developmental Biology* (1994/1998), pp. 96 f

[1086] In my view selectionism in a very broad sense, does not imply a strict Darwinian process of blind-variation-and-external-elimination, ➲ pp. 358 f.

[1087] R. Lewontin, *Gene, Organism, Environment* (1983/1985), pp. 279-280. Cf. also: M. Ruse, *The Mysteries of Mysteries* (1999), p. 167.

c) Forms, Fields and the Concept of External Memory

After having shown the stuffness of the phenotype and even its role as an evolutionary factor, I shall now advocate the more controversial case that, rather than only having phenotypes influenced by exformation, changes of exformation may, in a way, be stored systematically outside the phenotype in question. This additional argument is, in my view, not essential for my critique of germ-line reductionism, but it may still be an interesting proposal based on the concept of exformation.

In the claimed 'external' memory other genotypes do play an essential role, but from the viewpoint of a certain organism or evolutionary line this is a flux of exformation, since another evolutionary line is involved and the phenotypical interaction of this line is cardinal. This proposed alternative interpretation would also have consequences for our taxonomy, rendering some folk biological assumptions truer than a strictly Darwinian taxonomy would concede.

I first want to develop why we may speak of more or less given environmental forms. This merely resembles a phenotypic formulation for the concept of a niche. It will be argued that since these forms are probabilistic in nature we should rather interpret them as fields. Secondly, the concept of morphic resonance and exformational memory will be developed. Thirdly, possible taxonomic consequences are explored.

(i) Environmental Forms and Fields

Based on the stuffness of phenotypes shown above one can also interpret the interaction of phenotypes in terms of phenotypic *forms*. We have seen that despite the crucial role of genes, a fitness advantage is a property of a phenotype. The height of trees is advantageous and not directly assigned to a certain gene for height. But this property of an organism is not only a property of that organism, but a property of the interaction with phenotypes of other organisms, here with an interaction with other trees with a certain height. A structure is advantageous only in relation to a phenotypic context of the organism or species in question. In this sense a form is at least partly environmentally given.

This concept of an external form is largely identical with that of an ecological niche. In both cases the concept of potentiality is involved. An increase in height would increase the fitness of the phenotype. Environmental form is, firstly, a very broad application of the niche concept and, secondly, interprets it in a phenotypic sense. Contrarily germ-line reductionists regard a biotic niche, as a short cut with which to talk about genes. Despite the importance of genes, such a view, I think, neglects the stuffness of niches, based on the stuffness of the compounding organisms.

This form or niche is environmental since its location is external to the organism. Nevertheless, it is not strictly external, for, according to our partly constructivist view, it is related to the interaction of a certain phenotype. A niche is a part of the specific environment of a phenotype. Environment is here understood in a subjective Uexküllian sense[1088]. A niche for bacteria does not equally exist for mammals.

[1088] J. v. Uexküll, *Theoretische Biologie* (1928/1973). A. Pobojewska, *Die Umweltkonzeption Jacob von Uexkülls* (1993). Also: R. Lewontin, *Gene, Organism, Environment* (1983/1985), pp. 280, 282.

> We are confronted with a dialectics of the inner and the outer. The phenotype partly defines what aspects of the external world are exformationally relevant and the exformation partly moulds the phenotype.

The resulting notion of an environmental form is here used in a partly adaptationist and a partly constructivist way. The niche is partly given, partly constructed by features of the phenotype itself.

Despite the venerable tradition of the concept of form (reaching back in different ways to Plato and Aristotle) I think that it is important in the current context to replace the concept of form with the concept of a *field*, or, to denote the subject area, with a 'morphogenetic field'.

> Also, for example, R. Sheldrake proposed that biological forms, should in an evolutionary context rather be regarded as fields.[1089] Goodwin and Webster in detail have elaborated a morphological approach and have advocated a concept of hierarchical fields.[1090]
>
> Also proponents of biological systems theory, not influenced directly by a morphological tradition often advocated the reality of the phenotype. I think also these approaches may in principle be open to a field idea (L. v. Bertalanffy, B. Hassenstein, E. Jantsch, R. Riedl, G. P. Wagner, F. Wuketits, ➲ p. 152.).

In my view the concept of form should be replaced with the concept of fields, because a phenotype encounters these external forms in a probabilistic way.

For example flowers are not adapted to and 'exformed' by individual bees, although each pollinating bee contributes to this process. In this sense, the property of pollination refers rather to the 'beehood' at large or even to the 'pollen collecting insecthood' (➲ pp. 301 f.).

Hence in their effect environmental forms are rather reminiscent of physical fields or patterns in a neural net, where there are only fuzzy borders. Their effect is not that of rigidly defined forms or moulds with defined borders. Here, the negative aspect of essentialism, neglecting pluralism (as criticised by Hull, Mayr and Popper) can be prevented. Nevertheless, we may still think of an evolutionary logic of such probabilistic forms in an environmental context too. The actual forms or fields can be understood in an Aristotelian sense to be also determined by their parts, but still a cause in its own right. Only a probabilistic fit between the form of the organism and

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[1089] R. Sheldrake has contributed to the development of the notions morphogenetic field and morphic resonance. Sheldrake's book *The Presence of the Past* is inspiring, but some of his basic notions stay opaque. I shall try to contribute to a further clarification of these ideas. E.g., R. Sheldrake, *Das Gedächtnis der Natur* (1988/1991), pp. 130 f., 143 f.

[1090] G. Webster, B. Goodwin, *Form and Transformation: Generative and Relational Principles in Biology* (1996). I only had a glance at this book upon correcting this work. Although I have partly taken the book into account I had not the opportunity to elaborate in detail on the similarities or differences of my field conception to the one in that very interesting book. See also: B. Goodwin, G. Webster, J. Wayne-Smith. *The 'Evolutionary Paradigm' and Constructional Biology* (1992).

varying instantiations of the niche is needed (whereby the niche is partly externally given, partly a result of the organism and similar organisms).[1091]

Once more, such an argument requires also an adaptationist component complementing the constructional component (On the critique of process reductionism ➲ pp. 333 f.).

(ii) External Memory

The proposed external biological memory does not reflect a fundamentally new mechanism, but is rather intended as a different interpretation of known facts. Besides the stuffness of the phenotype being an evolutionary factor constraining and directing evolution, I, of course, agree that genes are the main stores of evolutionary change. Nevertheless, I think that exformation not only plays a role in constituting the phenotype, but also that changes in the exformation may in a way become inherited. This inheritance is normally based on the inheritance of another germ-line, but from the viewpoint of a focused evolutionary line this is still exformational.

Firstly, I suggest that organisms normally not only adapt to a given environment, but that they also choose, alter and construct that environment (Figure 10). The result of this changed exformation sometimes also affects their descendants. Secondly, I propose that from the viewpoint of a certain evolutionary line other evolutionary lines may in a way serve as dynamic external memories as well. This could be formulated as the morphological resonance of morphological fields.

(1) Organisms do not only adapt to the external world, as Darwinism has always emphasised (➲ pp. 358 f., 394 f.), but they construct their environment to some extent themselves.[1092] A strong exformational change could be achieved by migration. Even locomotion as such creates statistical patterns of environments. Of course genetic *in*formation plays a role in what exformation will become chosen, but nevertheless these exformational aspects can not be reduced to genes. Acquired exformational properties could at least to some extent – in interaction with genetic information – be passed on to progeny as well. A migrating organism may have the property to stay at the place where it had found favourable conditions. These positive experiences are in a way passed on to the progeny since the progeny is from its birth onwards exposed to the same favourable exformation.

But organisms also more directly alter the external world as it becomes part of their environments. They tread down paths, dig out burrows, build nests and establish signals.[1093] Often, although not always, these changes are advantageous to certain genes, individuals, groups or species.[1094] For example, paths or nests may be used by several successive generations of one kin group.

Even more obvious are cases of the transfer of acquired knowledge to other organisms in an exformational non-genetic way. Young birds have been shown in

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[1091] Still a process like selection in its broadest sense is required. On process reductionism, ➲ pp. 333 f.

[1092] Cf.: R. Lewontin, *Gene, Organism, Environment* (1983/1985), pp. 273-275, 279 f.

[1093] See: R. Margalef, *Perspectives in Ecological Theory* (1968). Quoted in E. Jantsch: *Die Selbstorganisation des Universums* (1982/1988), p. 202.

[1094] On the units of selection debate ➲ pp. 264 f.

experiments to imitate the songs also of 'foster' parents. More complex observational learning is known, for example, from monkeys, and of course also from humans.

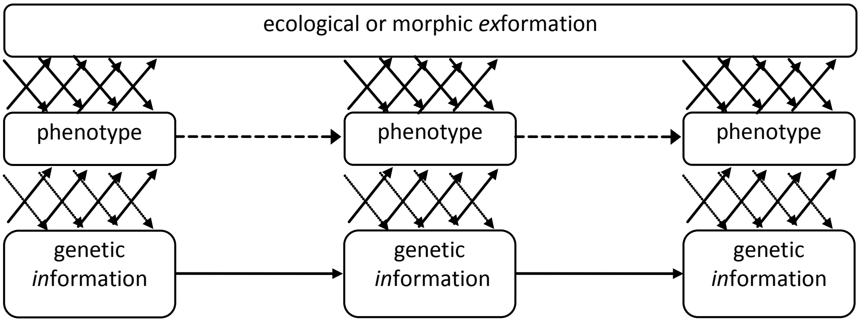

Figure 10: Flux of formation also considering the concept of external memory.

But Dawkins in a certain sense is right when he argues that "the accidental incorporation of a pine needle instead of the usual grass is not perpetuated in future 'generations of nests'."[1095] Nevertheless, firstly there are, as the previous point shows, also extra-genetic traditions which are passed on in animals. Here direct observational learning and learning from the products of the parents can transfer changes exformationally. The change of the exformation is also transferred in the migration example. Secondly, when the information transfer is in principle limited to the existence, for example, of a particular nest which is used for several generations only, the role of exformation indeed differs considerably from that of the germ-line. But this does not imply that this exformation transfer is an evolutionary irrelevant phenomenon. Thirdly, even in the nest example exformational changes may be preserved, for more than the lifetime of a particular nest. If in the pine population certain pines with needles, normally used for nests, with an improved water resistant property become predominant, this will cause a permanent change in the exformation of the nest building bird. This phenotypic change of the pine may take place because of an environmental change or because of some genetic mutation. Even if this change in the pine is genetically caused – informationally from the viewpoint of the pine – it is still exformational from the viewpoint of the DNA or the phenotype of the bird. I do not deny differences between informational and exformational inheritance, but I do oppose the terminological neglect of exformation. The main difference here is that the exformational change, if advantageous, is not an adaptation, but rather – to use Gould's and Vrba's terminology – an exaptation.[1096] Those birds which profit from this change will also presumably have a reproductive advantage, but the changed exformation itself has been and is currently not selected for this reason, but because

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[1095] R. Dawkins, *Replicator Selection and the Extended Phenotype* (1978), p. 68.

[1096] S. J. Gould, E. Vrba, *Exaptation – A Missing Term in the Science of Form* (1982/1998).

of an advantage for pines with such a property. I do not want to limit my approach to evolution in cases of adaptations. Although not being an adaptation, here a relevant permanent change in the exformation of the bird species actually has occurred. But I think there are also examples where the storage of a structure based on another evolutionary line may even be interpreted as an adaptation.

(2) Now two coevolving symbiotic species (mutualism) will be interpreted as their mutual external memory.

> This idea may in some regards also be extended to predator-prey relationships. This may appear peculiar: “After all, hares do not sit around constructing lynxes! But in the most important sense they do”[1097]. I have pointed out before that a predator-prey relationship may not only have synergetic properties, but, in an of course limited sense, also certain properties advantageous to *both* species (➲ p. 305). But here I confine myself for simplicity reasons to cases of symbiosis (mutualism).

As an example we discuss the co-evolution of flowers and pollinating insects. During their evolution flowers evolved presumably from at first wind-pollinated plants, and became increasingly adapted to insect pollination. Pollinating insects in turn evolved from non-pollinating arthropods, and became increasingly adapted to flowers. Flowers and pollinating insects can be understood as mutually interdependent environmental fields for each other. Both are not only influenced by the others environmental field, but each in turn influences the other’s field – a feedback-loop is closed (➲ pp. 409 f.). In the section on the unit of selection debate I have advocated the existence of ecological wholes which are not necessarily subverted by selfish species (➲ pp. 304 f.). Here I take ecological wholes with an increased fitness for granted. The evolutionary interaction of two (or several) symbiotic species, which are fitter than each species on its own, may lead to a coevolutionary process, where the involved species are mutually adapted and build a synergetic whole. Such a whole may indeed be an irreducible level of description, but this whole may still be described from the viewpoint of a single species as an adaptive transformation of each species to the structure of the other one. This results for each species in an advantageous change in their exformation. Nevertheless the ecological unit as a whole should not be neglected, since the sum of the involved species is fitter than each one on its own. In this (of course limited) sense the pollinating insect species is part of the flower species and vice versa. Analysed on the species level, the co-evolving species provides a changing exformation, which is rather an adaptation than an exaptation➲[1096] for the species in question.

> This approach may resemble Dawkins’ concept of an extended phenotype, which I have approved. However, this application rather turns this concept upside down.

If a pollinating insect species on an island becomes extinct because of a hurricane, we cannot conclude from the fact that the *in*formational evolutionary line has died out that the external memory of the species will necessarily immediately vanish as well. As long as the corresponding plant type does not immediately also become strongly diminished, insects of the same or a similar species could become blown to this island and will find perfect environmental conditions there. And why should it not be

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[1097] R. Lewontin, *Gene, Organism, Environment* (1983/1985), p. 282.

appropriate to interpret this in the sense that the exformation of their predecessors is still present?

It should not be denied that genetic inheritance in the co-evolving species is a precondition for this process as well. But firstly, phenotypes play a crucial role in this interaction, because the interaction of species is defined phenotypically (➲ pp. 317 f.) and the advantageous phenotypic property may be realised by different gene combinations. Secondly, from the viewpoint of a certain evolutionary line its evolution is in any case not shaped by its information and its own genetic code alone, but by the dynamic change in the other co-evolving species as well. That, from this viewpoint exformational, species, is of course itself based on its information and exformation as well as the feedback from the dependent evolution of the first species.

This dynamic, possibly even adaptive, change in exformation, which is normally based on other organisms, I call a bit anthropomorphically 'memory'.

> The term memory here should not imply a full identity of the stored and retrieved information. Although this is implied by the use of this term in computer science, this is not a defining characteristic for example of human memory. Here a further information processing takes place and thus the information becomes somehow changed (➲ pp. 316 f.).
>
> The idea of an external memory may possibly generalised to other cases of larger wholes. We have discussed other wholes in the section on the unit of selection debate. It might be generally possible to regard the components of a whole as (synergetic) mutual external memories of each other.

In this section the concept of an external memory has been proposed as an additional argument against germ-line reductionism. However, the existence of exformation and of inner phenotypic constraints as its own evolutionary factor already refutes this particularly radical interpretation of the here accepted central dogma of microbiology.

d) A Partial Revival of Morphological Taxonomy?

In how far are the preceding considerations relevant to the *dispute about universalia* and biological taxonomy. The unit of evolution or unit of selection debate has been treated above (➲ pp. 264 f.), and here I only argue that exformation and phenotypes are evolutionary factors in their own right. Still this also could have bearings on the unit of evolution debate.

Not only gene-Darwinians, but Darwinians in general have in principle denied the existence of higher taxa and asexual species. This is due to the missing flux of *in*formational between different species and between different asexual organisms. Moreover, this is due to the general neglect of form as an evolutionary factor in its own right. Hence, higher taxa or asexual species were regarded not to have any causal relevance. In this sense asexual organisms do not exist as species. Higher taxa and asexual 'species' were regarded as mere notions of convenience, which catalogue organisms or species according to their distance of informational descent. Although we have seen that advocates of the evolutionary synthesis have rejected germ-line reductionism, they still have not explicitly claimed that the form of the phenotypes is an evolutionary factor in its own right.

Based on the assumption that the goal of taxonomy is to of reconstruct the (informational) phylogenetic tree, the analysis of DNA sequence data has largely replaced morphological analysis (euphemistically called 'traditional phylogenetics') as the standard methodology. Only recently it became acknowledged that even for this goal, morphological studies are necessary means for a proper taxonomy.[1098] But here we are concerned with an even more fundamental issue.

Opposed to standard taxonomy, transcendental and romantic biologists have always held that asexual species and higher taxa are real and have stressed the relevance of the morphological structure.

Given that taxonomy should only mirror the line of informational descent in a phylogenetic tree, Darwinians appear to be right to focus only on species (as long as we are concerned with sexually reproducing evolutionary lines). There is no direct exchange of *in*formation between asexual organisms of one phenotypic 'species' or generally between different species of the same taxon (appart from specific effects of bacterial transfer). Nevertheless, this taxonomic criterion that equates taxonomy with the reconstruction of (informational) phylogenetic relationships may be seen to be particular to a specific philosophy of nature, including Darwinism.

If one accepts this account of genetic information, does this imply that the view of romantic biology or folk biology is completely wrong in saying that 'species' of asexual organisms and higher taxons are at least in some way real as well? Do we have to except the premiss that restricts the goal of taxonomy to 'information' and *a priori* rules out the study of 'exformation'?

(i) The Evolutionary Factor of Constraints as Object of Taxonomy

If the morphological and functional structure of phenotypes is understood as an evolutionary factor, taxa could be used to express such causally relevant properties species (or organisms of an asexual 'species') have in common, like the exoskeletons of arthropods which partly determine the evolutionary pathways of these species (➲ pp. 322 f.). In a morphological view one might argue that it is of secondary importance whether this group has a common descent. It is important that they have the same basic morphological constraints, a similar body plan (*Baupläne*), because this is causally relevant. One may object that there may be no flux of *in*formation between morphologically similarly constrained organisms or species. One may reply that questions of descent are, in such a view, not the relevant questions anyhow, but that a focus on the structural (and functional) similarities and differences raises the more interesting questions.

I regard the indicated different views as complementary rather than opposed. It may be systematically helpful to order organisms or species according to such factors, in principle regardless of their descent. But since adaptation also plays an important evolutionary role, the ordering of species according to their informational line of descent also provides us with much interesting information about their former environment and their properties as well.

[1098] W. Sudhaus, *Die Notwendigkeit morphologischer Analysen zur Rekonstruktion der Stammesgeschichte* (2006).

(ii) Morphological Resonance as Object of Taxonomy

Could a mutually external memory of a system of co-evolving species somehow unify similar species (or similar organisms of an asexual species)? The environmental memory of flowers is neither built by a single bee nor usually by a single species of bees. A flower species will normally be adapted to the pollination of the beehood or to a certain extent to the pollen collecting insecthood. Such relationships hence may render the (exformational) existence of (some) species of asexual organisms and of (some) higher taxa possible. These partly adaptationist and partly constructivist aspects may also play a role in homologies and evolutionary convergence (➲ pp. 326 f.).

It may be still more convenient to order organisms and species only according to their line of informational descent. The proposed criteria may force the taxonomist to abandon the convenient hierarchical classification, which has the advantage of clearly localising certain species within only one taxon of each level. In my proposal one species may in principle be a member of several taxons at a time based on morphological constraints or morphological resonance.

In any case a refutation of gene-atomism and germ-line reductionism is much more urgent. It is possible to accept the importance of exformation and phenotypes as evolutionary factors, and still to advocate a systematics which focuses exclusively on informational lines of descent and neglects morphological constraints and resonance. I here only wanted to point out, that it is in principle possible to advocate changes in taxonomy as well. It is not given *a priori* that systematics has to limit itself to the lines of informational descent.

e) Summary

In this section 8.3 on germ-line reductionism we were concerned with the question of whether the different levels of genetic selection, which we discussed in a previous section (➲ pp. 264 f.), are the only relevant aspects of evolution and whether the corresponding phenotypic entities can be regarded to be the mere vehicles of genotypic units of evolution.

(1) The central microbiological dogma has been described as an updated version of Weismann's germ-plasm theory. Some challenges to this theory were outlined. Nevertheless I took this theory as a currently valid hypothesis and focused on the critique of the particular radical germ-line reductionist interpretation of this theory.

(2) A concept of exformation has been proposed, reminiscent of the earlier critique of a downward reductionist understanding of substance. A hylomorphic understanding of substance has been advocated instead. This understanding challenges a simple view of inner and outer. It has been argued that phenotypes are not completely reducible to the germ-line, since they are not only based on genetic information, but on exformation as well and exformation is not itself coded (in all its details) in the genes. Although not denying the importance of the genotype, the phenotype determines what genetic information is read and how it is interpreted. Moreover, phenotypes are causes of their own development. As Lewontin puts it, a phenotype is a "first order Markov process in which the next step depends upon the present state". Accordingly, an organism bears evolutionary constraints and, vice

versa, possible directions. These constraints need not be adaptive. Nonetheless, the morphological and functional constraints of phenotypes can be understood as evolutionary factors.

(3) A concept of environmental forms (similar to a niche) has been suggested, which exist in relation to a certain phenotype. The concept of forms is replaced by the concept of fields in order to account for probabilistic pluralistic influences, which have been ignored by some earlier morphological traditions. Goodwin and Weber, for example, propose a field understanding of form as well. Based on the co-evolution of symbiotic species, it is advocated that some properties of a focused species may in a way even be exformationally stored in the co-evolving species and hence inheritable outside of its own genome.

(4) It has been pointed out that taking the phenotype seriously, may have consequences for taxonomy as well. Darwinism regards asexual species and higher taxa as not truly existing, but as mere nominalistic conventions to describe the (informational) distance of descent. Based on the concept of morphological and functional constraints as evolutionary factors one may have to treat species or organisms with similar constraints as members of a taxon even if they are not united by common descent, since their structure independent of their descent is evolutionarily primary. Hence, common taxonomy would need to be supplemented by a truly morphological kind of taxonomy. Another aspect which systematics may have to take into account is the morphological resonance which may have an equal effect for similar species or organisms of asexual species. I have conceded that one may, for reasons of convenience, reject these taxonomic proposals without necessarily rejecting the proposed concepts.

Here the primary goal was to show that although the central dogma is accepted as a (currently) valid hypothesis, germ-line reductionism does not need to be valid. The phenotype has been shown to be partly based on exformation and to be full of stuffness. Additionally, morphology and function of the phenotype constrain and direct evolution. The proposals focus attention upon the neglected but fundamental evolutionary role of the phenotype itself. The phenotype needs to be rediscovered not only a vehicle of selfish genes, but as an evolutionary factor in its own right.

Chapter 9: Transcendence of Process-Reductionism

A metaphysic that was truly evolutionary would have to deal with the evolution of its own evolutionary mechanisms. Opposed to this, universal Darwinism advocates a process monism. In this chapter Darwinian process reductionism is discussed and criticised and some proposals are made, concerning how a more evolutionary theory of evolution may be achieved.

Universal Darwinism, in its gene-Darwinian but also in its process-Darwinian version (➲ pp. 205 f.), advocates a static monistic view of the evolutionary process itself. According to these approaches all evolutionary processes can in principle be reduced to the unmutable process of blind-variation-and-external-selection. Darwinians often regard the evolutionary mechanism of natural selection as itself externally and eternally given and in principle exclude a true self-transcendence of processes. Hence, paradoxically the arch-opponents of fixism and essentialism – those such as Darwin, Dawkins and Dennett – are, in respect of processes, radical promoters of fixism and essentialism.

Darwinian process monism refers back to its historical Paleyan Newtonian roots. Although Darwinism also undermined this, the soil on which it is built, it in a Paleyan-Newtonian manner still advocates one eternal law of nature, simple and invariant, as if it were preordained. Natural selection in some regards ironically resembles natural theology. There is still a certain Platonism inherent in Darwinism – albeit materialistically and mechanistically transformed.

> Also, for example, Lyell's actualism influenced Darwin and thereby Darwinism. Actualism also stresses that forces are not changed in quality or in quantity throughout time. According to actualism the observation of present geological processes, could fully explain the change of geological formations during the history of the earth.

The concept of an unchangeable law of evolution can often be found in Darwin's own writings, even before he formulated his specific theory of evolution.[1099] The later evolutionary synthesis, despite some pluralistic aspects, stressed the unchangeable blindness and externality of selection. Finally, gene-Darwinism advocates a radical version of Darwinian process monism and, likewise, promotes the idea that a process like sexual selection is essentially the same process as the natural selection of selfish genes (➲ pp. 142 f.).

In this chapter I oppose a radicalised Darwinian process reductionism. In the introduction I have already clarified that my approach still draws strongly from Darwinism and that in a very broad understanding of Darwinism my approach could even be regarded as a quite Darwinian approach in itself, since it, for example, accepts the importance of variational evolution (➲ pp. 12 f.). Many concepts of the different paradigms of Darwinism and 'pseudo-Darwinism'➲[443] are, in my view, indispensable

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[1099] E.g., Ch. Darwin, *Notebook B* (Ed. by D. Kohn, 1987), orig. p. 101. Confer also *Notebook E,* orig. p. 3 (refering to Malthus). Generally, ➲ pp. 162 f.

to evolutionary theory. Nevertheless, I do oppose radical Darwinism in criticising pan-adaptationism and pan-selectionism.

Moreover, my criticism is not only concerned with this radical Darwinism, but with some aspects basic to Darwinism in general. To prevent misunderstandings, I concede and agree that the Darwinian process (natural selection), *if* understood in a very broad (up to an almost tautological) sense, is *the* central mechanism of evolution. But I think that such a broad understanding of Darwinism, conceals the fact that the evolutionary mechanism is itself evolving and the role of developmental constraints and chance processes. Natural selection itself, in my view, is actually not one constant mechanism, valid in an equal way from the amoeba to Einstein, but, when put under close scrutiny, many mechanisms become apparent. These processes may have some aspects in common, but in others they differ essentially and have changed during evolution. To make these changes apparent and to exclude tautological aspects of the definition (➲ next sections), I propose a stricter definition of Darwinism, but one which is still in accordance with the evolved meaning of that term. I shall show that evolutionary processes differ from that more strictly defined Darwinian process. I shall argue that variation on certain explanatory levels is not necessary equally blind and that 'hetero-selection' becomes supplemented by 'auto-selection'. I argue that evolutionary processes can gain a limited autonomy from natural selection. Of course, here only some proposals were made about how such a more evolutionary theory of evolution might be achieved by outlining what may count as a process in its own right. This work could not exhaustively deal with all possible mechanism, it only advocates a different line of research.

Taken together with the above argumentation that there are different evolutionary levels (➲ pp. 264 f.) and that phenotypes can be regarded as evolutionary factors in their own right (➲ pp. 311 f.) this results in an interpretation of evolution, which in any case differs considerably from gene-Darwinism – but also from Darwinism in general. A differentiation between evolutionary processes would also render simplifying claims absurd, like, for instance, the claim that the human emotional system, the hypothalamus and limbic system "evolved by natural selection"[1100]. This does not distinguish between the levels of evolution, or whether say this was due to what I call 'auto-selective' or 'hetero-selective' processes. Darwinism, despite its indispensable contribution to evolutionary theory, has to be replaced by an evolutionary theory of evolution (➲ p. 12).

One may be inclined to argue that Darwinism in a strict sense has been already refuted by the previous critique of entity reductionism (Chapter 8), since strict Darwinism was often also defined by its reductive attitude towards groups. In our discussions of different kinds of genic reductionism this aspect of Darwinism has been challenged.

[1100] E. O. Wilson, *Sociobiology* (1975), p. 3. Wilson apparently has a much more complex understanding of evolution. (Cf.: Ch. J. Lumsden, E. O. Wilson, *Genes, Mind, and Culture* (1981), but the metaphor of an unchangeable mechanism of evolution, i. e. of natural selection still dominates his writings.

However, a refutation of Darwinian process-monism, which I here take as the core of Darwinism, does not follow – at least not directly.

> Because Darwin's own Darwinism was individualistic, or generally reductionist, gene-Darwinians have sometimes been regarded as the only true – albeit more radical – successors of Darwin, since they advocate a completely reductive view of evolution. Under this definition the last chapter has to be understood as a critique not only of gene-Darwinism but also of Darwinism in general. I, however, define Darwinism, more cautiously, with regard to processes.

If one accepted the above results of different levels of evolution, one would still be a multi-level Darwinist (➲ pp. 152 f., 264 f., 284 f., 301 f.). In particular some of the main opponents of gene-Darwinism and defenders of a richer ontological inventory (e.g., Campbell, Hull) became supporters of universal process Darwinism (➲ p. 152). Process-Darwinism is even possible if one accepts the autonomy of cultural processes. It has been shown that Darwinian processes could be found in psychological trial-and-error theory, the theory of science and some economic proposals (➲ pp. 207 f., 216 f., 221 f.).

Nevertheless, an acceptance of synergetic or emergent entities and of top-down causality, in some respects puts reductionism, also in regards to processes, into question. Why should there not be any synergetic and emergent processes as well? This becomes particularly problematic in the light of a *Whiteheadian process philosophy*, in which entities are regarded as processes, and processes *vice versa* are regarded as entities.[1101]

I have argued that the concept of a single gene somehow corresponds to the concept of a Darwinian process of blind replication and external elimination (➲ p. 218). I shall argue in this chapter that, for example, species can also be regarded as evolutionary processes. But these processes, despite some similarities, are not identical to natural selection. For instance, a species allows for a synthesis of evolutionary lines (sexuality and mixture of subpopulations). Although there is no blending inheritance, the splitting up of evolutionary lines is complemented by a certain, and of course limited, possibility of synthesis. Moreover, species may be regarded to be less blind than single sexual organisms, since new adaptive valleys can be crossed, based on the recombination of genes from a larger gene pool. Furthermore, a species changes the adaptive landscape itself, since, for example, new forms of cooperation can now become adaptive. From a Whiteheadian perspective it should not be a surprise to regard phenotypes, as I argued in the last chapter, to be evolutionary factors in themselves, constraining and directing possible evolutionary pathways. But morphological 'logic' is not identical to a Darwinian process; the changes can differ from those predicted on Darwinian adaptationist grounds (➲ pp. 322 f., 368 f.). Here, I shall show that selection is not necessarily blind and externally given on all levels and that evolutionary processes can gain a certain autonomy.

Hence, in this proposed view of nature, Darwinian processes are not a sufficient explanation of biological and cultural evolution. "Darwin's dangerous idea" –

[1101] Also in modern physics matter and energy are in principle convertible; ➲ also footnote 949.

understood not in too broad a sense – is *not* the "universal solvent, capable of cutting right through the heart of everything in sight".[1102] Organisms are not only objects but also, to some extent, subjects of evolution, whereas the evolutionary mechanisms are not only subjects but also objects of evolution. Since Universal Darwinism, in its gene-Darwinian or only its process-Darwinian versions currently 'cannibalises' the social sciences, time has come to put emphasis on the inconsistencies of this view and on the evolving nature of the evolutionary mechanism itself.[1103] Only in a truly evolutionary framework, not delimited only to one algorithm, we can realise the full range of freedom we humans have, to change these mechanisms, especially in the social stratum.

I shall first point to some inconsistencies in the process Darwinian approach and discuss two possible Darwinian tautologies (9.1). This discussion results in the already mentioned redefinition of Darwinism and a proposed spectrum of theories reaching from radical Darwinism to approaches, which stress inherent tendencies and a less wasteful evolution (9.2). Subsequently, I discuss the single aspects of this definition and show the existence of synthesis, auto-selection and directed variation. I focus mainly on biological evolution, since this is the most controversial case. Finally, it is shown that new processes can gain some autonomy and, based on Kant, systemic circularity or selfreferentiality is discussed as a criterion for the emergence of a 'new' synergetic process (9.3).

9.1 Inconsistencies and Tautologies of a Darwinian Mono-Mechanistic Metaphysic

In this section it will first be shown that the claim of process Darwinism that there are different levels describable as evolving exclusively by Darwinian processes, leads to inconsistencies and actually to changed or compound processes which not equally appear to be Darwinian. Secondly and thirdly, Darwinian pan-adaptionism and pan-selectionism will be scrutinised. It is argued that both claims could only be made due to a partly tautological definition of adaptation and of natural selection. This discussion will build the basis for my stricter non-tautological definition of Darwinism.

a) Inconsistencies of Different Levels of Multilevel Darwinism

Universal Process Darwinism (➲ pp. 216 f.) is a metaphysic focusing on the simplest possible evolutionary algorithm, the Darwinian algorithm of natural selection. This metaphysic interprets all other evolutionary processes in a downward reductionist way. All (relevant) evolutionary change comes into being through Darwinian algorithms. Although a theoretical unification under the one and only flag of process Darwinism has much appeal (exactly because of its simplicity), the exclusive application of Darwinian algorithms in many ontological strata leads to contradictions,

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[1102] D. Dennett, *Darwin's Dangerous Idea* (1995), p. 521.

[1103] This may in some respects for example correspond to Lewontin's view that evolution should be represented by the metaphor of construction instead of that of adaptation. R. Lewontin, *Gene, Organism, Environment* (1983/1985), pp. 279-280.

even if a particular application of process-Darwinism appears to be justified on its own. If one favours many different levels of selection (as I did above, ➲ pp. 221 f., 264 f.) these levels are not independent from each other.

Selection processes, particularly if they belong to a *part-whole relationship*, like individuals and species, may have effects on each other. As mentioned, the proliferation of species may be less blind than thought, because more combinations could be tried than in evolutionary lines of asexual organisms and, likewise, combinations could be tested in advance in sub-populations. From the viewpoint of the whole – which I argued to exist – evolution is less blind. Moreover, the whole, as I have shown, could now have an inner dynamic leading to a limited but real autonomy from environmental selection (➲ pp. 291 f.). But, I think, as far as parts – the individual organisms – are concerned, matters also from their viewpoint have changed; their reproductive prospects change as does their evolutionary landscape. The organisms, for example, can now be members of interbreeding synergetic groups, and may thereby enhance their fitness.

> The process-Darwinian claim of the equivalence of higher evolutionary levels to simple natural selection generally conceals the resulting autonomy of new processes (➲ pp. 396 f., 409 f.).

The other type of relationship between selection processes one may call *nested (secondary) selection*. Darwinian selection processes of that kind are, for example, claimed to enable the development of the immune system, the brain or is given in psychological trial-and-error learning (➲ pp. 227 f., 235 f.). Let us take the example of organisms with an ability to learn by trial-and-error, which is describable as a Darwinian process. What is the difference between such a nested relationship and a part-whole relationship of selection processes? The trial-and-error learning, which is also a *part* of the functions of that organism, does not directly change the information of the organism, the whole. This is different in the part-whole relationship of species and individuals.

However, here one can also argue that nested selection processes could reduce the blindness of evolution in a way. At the level of the organism nested selection processes lead to plasticity. This plasticity, of course, may itself be an object of natural selection. Still, the process of evolution has changed considerably. In the interaction with environmental influences (exformation, ➲ pp. 316 f.) new optima may be reached without or with only a little change in the biological information. On the explanatory level of the organism a feedback loop with the environment is created, leading to a flexible adaptation of the organism. The organism does not need to explore every single possibility of the environment genetically, but does this via trial-and-error learning. This way of exploring the evolutionary landscape at the level of organisms is less wasteful – and in this sense less Darwinian – than achieving the same result, by the proliferation and selection of particular 'hard-wired' instincts. Still a fundamental change may only be achieved by biological mutation, but now the organism could flexibly and quickly adapt to smaller fluctuations in the environment without the need for biological mutations. Although this is different from the part-whole multi-level selection process, the genetic makeup itself is not altered by the nested selection process and the evolutionary line is to some extent open to respond to new challenges by trial-and-error learning. The line to some extent gains an independence from momentaneous changes in the environment.

One may of course argue that this does not make a difference, since – according to the assumptions we have accepted – the composing processes of individual selection and the trial-and-error process are both Darwinian. But the resulting effect for the organismic level differs considerably.

And I think we also should and want to make a difference whether we as biological entities have to die, or whether only our trials, thoughts and theories die instead of us.[1104] A theory concealing this difference is in my view wrong – at least in its emphasis.

Moreover, this is a good example which shows that, even if we assume both composing processes were purely Darwinian processes, the resulting synergetic whole of an evolving asexual organism or species can be said to be less blind. This may be an example which shows that the concept of synergetic wholes, developed above with regard to the unit of selection debate, is applicable to processes as well. In regard to a part-whole relation we discussed earlier the case that successive individual selection within a self-referential system could lead to the synergetic property of a certain autonomy from adaptation to an external environment (➲ pp. 291 f.). Even if the processual atoms are Darwinian processes, the resulting processual whole can behave quite opposed to Darwinian processes.

> Another example for such a synergetic property is that habits, which may become established in a trial-and-error way, may, as Popper has shown, change what becomes selected. In this regard use could somehow direct inheritance, although only in a quasi-Lamarckian sense.[1105]

Equally the initial universality of the theory of operant conditioning has also been challenged the other way round by biological Darwinism. I have outlined earlier that the theory of conditioning was intended as a general approach to psychology and it has even been proposed to subsume classical conditioning as a particular case for operant conditioning. In which case the universality of trial-and-error learning, which is today only rarely supported, would have been shown. Since we have shown operant conditioning to be a process-Darwinian approach – despite being opposed to biologism – a universality of process-Darwinism in psychology would have resulted. But, besides other influences, the understanding of the biological underpinnings of human behaviour and learning – mostly understood in Darwinian terms – have in particular undermined the universality of this approach. Biological preparedness has been shown to constrain and direct which associations become established and which trials are made. [1106] Also other more complex types of learning and understanding have been

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[1104] This has been stressed by P. Munz, although he draws rather Darwinian conclusions, *Philosophical Darwinism.* (1993).

[1105] K. Popper, *Objective Knowledge* (1971/1992), pp. 272 f. This, I think, refers back to the Baldwin effect.

[1106] J. Garcia and M. E. P. Seligman played an importaint role in exploring the concept of biological preparedness.

established, with a biological basis partly of its own, like observational learning or processes of problem solving. Additionally, the general cognitive turn claiming a multitude of – partly learned – different cognitive processes, challenged the universality and exhaustively of the trial-and-error process of operant conditioning (➲ pp. 227 f.).

Likewise, process-Darwinian economics – which have to be distinguished from biologistic Darwinian economics[1107] – come into contradiction with a partly biologised psychology. According to this type of Darwinian economics the 'struggle for life' and the 'survival of the fittest', in a way similar to that of the biological process, takes place on a new ontological level, on the level of economic agents. I have mentioned, that the Friedmanian belief in severe competition was actually historically influenced by the concept of natural selection and survival of the fittest (➲ p. 198). But economists of the Chicago school have also to assume that some preconditions have to be met under which severe competition in fact leads to the economic survival of the fittest economic agent. Such preconditions are complete information and rational choice of the economic agents. But Darwinian biology and psychology shows that exactly these assumptions are violated, since the information processing capacity of humans is limited and rational thinking is to some extent domain specific and not free from systematic errors.[1108] Hence, Darwinian biology and psychology undermine pan-adaptationism of Darwinian economy.

In conclusion it is apparent that components of process-Darwinism in different subject areas not necessarily support each other theoretically, but can and often do contradict each other. I do not deny, that despite such inconsistencies, Universal Darwinism still has a certain appeal. This may also partly be due to the tautological *aspects* of this theory. In the next two subsections we will try to separate the tautologically true, but largely meaningless, aspects of Universal Process Darwinism from the testable and meaningful aspects of it, before going on to achieve a more precise definition of a Darwinian process.

b) On the Tautological Basis of Pan-Adaptationism

There is a broad dispute about whether and to what extent Darwinism is marked by tautological aspects.[1109] We have already briefly discussed the tautological aspects of

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[1107] ➲ pp. 236 f., also pp. 173, 198.

[1108] See, for example, the recent evolutionary literature on the implication fallacy and the Wason selection task: L. Cosmides, J. Tooby, *Cognitive Adaptations for Social Exchange* (1992). G. Gigerenzer, *Domain-Specific Reasoning* (1992), ➲ footnotes 886 f.

[1109] Only a selection of literature on this matter can be mentioned here. It is not unproblematic to distinguish between two camps of writers, since different authors have discussed different aspects of potentially tautological aspects of pan-selectionism or pan-adaptationism. Nonetheless, as an introduction it may be helpful to distinguish two opposed directions, one stressing the tautological aspects the other denying it. Tautological aspects of pan-selectionism or pan-adaptationism have, for example, been criticised by: Midgley (1978/1995), pp. xx, 139, 161. S. J. Gould, R. C. Lewontin (1979) and Spaemann and Löw (1981), p. 242, von Sydow (2001). After the current work had first submitted as a PhD thesis the excellent analysis by Rosenberg and Bouchard (2002/2008) has been published. Another group of authors have objected to the idea that tautologies play an important role in immunising the Darwinian psychological trial-and-error theory, which are analogous to those in biological Darwinism (➲ pp. 227 f).

I distinguish between two aspects of process monism, as promoted by universal Darwinism, which are related to corresponding possible tautologies. Firstly we discuss pan-adaptationism and, secondly, pan-selectionism. In both sections it will be shown that the views, if valid, are in certain respects based on a *tauto-logical* argumentation, which according to the etymological meaning of the original Greek term means that what has been said or assumed before is merely restated. Both interrelated tautologies are in different ways linked to a certain interpretation of the concept of the *survival of the fittest*, resulting in a concept of the *survival of the survivor*.

I do not, of course, advocate that Darwinism as a whole, either in respect to adaptation or in respect to selection, was thoroughly tautological, but I intend to point out tautological aspects which may often have been endorsed only implicitly, but still may have helped to immunise the Darwinian paradigm against criticism. I try to disentangle the tautological and the more empirical aspects of universal Darwinism and to show that, without a tautological argument, the universality of Darwinian processes – although not the existence of Darwinian processes – becomes doubtful.

> The tautologies discussed at this point differ from other tautologies treated in this work. But the tautological aspect of the falsificationist refutation of inductivism, discussed previously, is closely related (➲ pp. 213 f., 371 f.). We have also discussed a tautology of defining genes so broadly that they, by definition, become the unit of selection (➲ pp. 264 f.). Instead of redefining genes, one can similarly redefine wholes as being only their parts, even if a whole is more than the sum of its parts. Provided such a definition, it becomes a tautological and empty truth that larger wholes are not evolutionarily relevant, since they, by definition, do not exist (➲ pp. 277 f.).

Darwinian *pan-adaptationism*, often called 'adaptationism' for short, is the claim of the universality of adaptation which, in the present context, is understood as being based on natural selection. All evolving entities have adapted and adaptation is the only direction giving evolutionary process.

Adaptation, as a state, is often understood as the fit of an entity to its environment.[1110] Adaptation, as a process, is normally understood as the increased fit of an entity to an environment. To assume that, in this sense, adaptation exists, is, of course, not yet tautological.

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research programm: Dennett (1995), pp. 238-51; Hodge (1983/1985), pp. 58-59; Vollmer (1985/1988), pp. 274 f.; Wuketits (1995), pp. 99 f. Even Gould justly turned against some radical charges that all central aspects of Darwinism are formulated in a tautological way (e.g., 1973/1991).

Several authors cannot be grouped on either side of the line, since they do accept that there may well be tautological aspects of Darwinian explanations, but they do not advocate that this is necessarily a grave problem: Dawkins (1989/1982), pp. 179-194; Campbell (1960/1987), p. 385 f./p. 109 f.. Popper (1972), pp. 69 f. (cf. Popper, 1973, 83 1974, pp. 133 f., 1987). For a general discussion of these issues, cf: Bowler (1984), pp. 327-334; Isak (1992), pp. 150-152; E. Sober (1996/1998).

[1110] Gould and Vrba have called this an 'aptation'. St. Gould, E. Vrba, *Exaptation – A Missing Term in the Science of Form* (1982/1998), p. 54.

Moreover, I myself even would stress that all entities (perhaps apart from ultimate elementary particles in physics) have, to some extent, to be adapted to their environments.[1111] For example, molecules are stable only under certain chemical conditions. Even today atoms are known to be stable only under particular conditions of the physical evolution of the universe. Macroscopic objects of our day-to-day life trivially under certain conditions become unstable as well. Actually no biological organisms can exist, if they are, for example, exposed to fire for too long. A certain adaptation, in the sense of a minimal *fit of entity to environment*, is necessary and hence ubiquitous. All entities are to some extent adapted to their environments, otherwise they would not exist. If adaptation as state is in a certain degree a necessary condition for existence, a process of adaptation appears to follow. Those entities – atoms, biscuits, genes and species – which are not adapted will simply not survive.[1112]

Does this argumentation hence entail pan-adaptationism? No, pan-adaptationism is not entailed as long as one does not modify the meaning of adaptation in a tautological way. To argue that a certain minimal adaptedness is necessary, is not the same as to argue that entities are strongly adapted and only formed as result of adaptive processes. Even if adaptive processes play an important role, this does not imply that non-adaptive processes did not exist.

Still, pan-adaptationism has implicitly at least often been assumed to be valid, and, I think, this has been made possible by a subtle modification of the underlying understanding of adaptation. Pan-adaptationists implicitly or explicitly often seem to argue that all those entities which survive are generally more adapted, since they survive. Fitness becomes defined – as has actually often been done – by survival. Thereby the Darwinian claim of the survival of the fittest results in the tautological claim of the survival of the survivor. Such a tautological proposition, is obviously true, but meaningless.[1113] In regard to such a basis for adaptationism M. Midgley is completely right in being pessimistic when she asks "whether it is possible to invent any trait so disadvantageous that it could not be whitewashed in this way"[1114]. Of course, any entity, which survives, survives. Only those drops of water, those trees, tigers, tables and theories survive, which survive. In this sense adaptation is always given and in each and every existing respect valid; thus pan-adaptionism seems to follow. The result would be reminiscent of the pan-adaptationism of early design arguments and Paley's natural theology or of Leibniz's pre-established harmony.[1115] But current pan-adaptationism is linked to Darwinian naturalism, associated with struggle and not with preordained harmony. The earlier pan-adaptationism was based on theology, but Darwinian pan-adaptationism is – at least partly – based on tautology.

[1111] See also my concept of exformation, ➲ pp. 316 f.

[1112] Here we implicitly use a definition of natural selection which is later criticised as being too broad, ➲ pp. 350 f.

[1113] It is meaningless in the sense of not being falsifiable or verifiable. It of course still confers an ideological load.

[1114] M. Midgley, *Beast and Man* (1978/1995), p. xx.

[1115] Cf. also: R. Dawkins, *Universal Darwinism* (1983), p. 404; *The Blind Watchmaker* (1986/1991).

> Pan-adaptationism in general, in regard to a state of being, may indeed be called a 'Leibnizian paradigm'[1116], although, in regard to processes, Leibniz's concept of a pre-established harmony is rather diametrically opposed to the wasteful mechanism of natural selection. However, with regard to a tautological pan-adaptationism I, in any case, prefer to use Gould's and Lewontin's term of a Panglossian Paradigm. This term is named after Dr. Pangloss, Voltaire's caricature of Leibniz.[1117]

But how does this tautological argumentation differ from the non-tautological one above, which I supported myself? Previously we defined adaptation as the fit (or the process of an increase of fit) of an entity to an environment, a certain relation between inner and outer. In this definition adaptation is in principle falsifiable. Entities may become adapted to an environment, or – based on an internal dynamic or on chance – may evolve in another direction. Opposed to this, tautological pan-adaptationism defines any entities which survive as having adapted. Accordingly, properties which in the former sense would have falsified that an adaptation took place, like a stable inner dynamic in a non-adaptive direction, would also still count as adaptation, since this also confirms the survival of the survivor. Based on a definition leading to such a tautological claim, I am and everyone else is, of course, a pan-adaptationist. But, it should be obvious that an unmodified definition of adaptation by survival is not a reasonable premiss, particularly since the claim of the survival of the survivor is not at all informative.

If one instead adopts the non-tautological definition of adaptation which is based on an increasing fitness to an externally given environment, adaptation will definitely play an important role in evolution – but pan-adaptationism can be shown to be false. I name three types of explanation where this is the case.

(1) Systemic individual selection could, as I have argued, lead to trends which are not adaptive (➲ pp. 291 f.). I have shown that the self-referential interaction of individual selection processes – which on the individual level appear to be adaptive – could stabilise or develop properties which are not adaptive in regard to the environment of the system. Such inner dynamics could be stable until either the system breaks down or another system is installed by group selection. In regard to the environment of the system, neither the system nor its parts become more adapted. The evolutionarily relevant dynamic at the system level is not adaptive. Based on the self-referentiality of the internal selection processes, a new synergetic property of autonomy from the outside world comes into being on the system level. I later shall discuss this as a case of auto-selection, which does not necessary lead to an adaptation to an external environment (➲ pp. 394 f).

(2) Chance processes, playing a role in genetic drift or in the founder effect, may also lead to the establishment of non-adaptive gene-combinations in a gene-pool. But if one allows for many units of evolution, these processes can be regarded as parts of a larger adaptive process. For example, if one assumes a selection process at the group or species level, chance effects within the population could lead to the adaptive result

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[1116] D. Dennett, *Darwin's Dangerous Idea* (1995), section 9.2 *The Leibnizian Paradigm,* pp. 238-251.

[1117] St. Gould, R. Lewontin, *The Spandrels of San Marco and the Panglossian Paradigm* (1982/1989). ➲ footnote 813.

that, if accumulated in a certain sub-population, for example by a founder effect, it may become possible to cross adaptive vallies which would not have been possible otherwise. Hence chance processes may be part of a process which is itself adaptive (➲ pp. 302 f.).

But chance effects are also presumably equally often only side effects which, for example result from a given population structure, and may really lead to the establishment of partially non-adaptive properties. Also mutations, as the neutralists have stressed, are often neutral and can often by chance drift to genetic fixation in a population.[1118]

(3) Inner morphological dynamics or, more apparent still, developmental constraints of an evolutionary line have, according to the non-tautological understanding of adaptation, also to be regarded as counter-evidence to the claim that only adaptation to an environment determines the course of evolution. The morphology itself constrains and directs the pathways evolution could take. Morphology can either constrain possible variations or can itself act as a selecting force. The phenotypic morphology, besides the adaptation to an external environment, is an evolutionary factor in its own right (➲ pp. 322 f.).

It is actually difficult to disentangle internal and external causes in regard to morphology, but this, according to the above argumentation, is not only a problem for developmentalists, but for adaptationists as well. If it were not somehow possible to disentangle these two aspects then adaptationism does, as argued, not have its own empirical content, but only refers to the survival of the survivor (the empirical content of a Darwinian process is discussed separately in the next section). This distinction, however, does not lead leads to a problem in regard to point (a), nevertheless the distinction seems problematic here. It appears as if there are no evolutionary cases where either internal dynamics or a certain environmental adaptive pressure were completely absent. Evolutionary accounts have in fact always been concerned with entities in certain environments, the inner and outer of which seeming to be inseparable, related in an dialectical way. But this, I think, does not need us relapse into claiming adaptation tautologically. Despite the interrelationship between inner and outer, we seem to be able to distinguish what is relatively more due to outer than to inner factors. For example, it seems reasonable to regard the exoskeleton of arthropods as morphological constraints on the size of organisms, whereas those characters of the whale – originally a land living mammal – which are fish like, can, rather reasonably, be regarded to be adaptations to the aquatic environment. To evaluate the relative importance of internal or external factors may possibly involve comparisons to other species[1119].

But other proposals have also been made to disentangle the role of the inner dynamics of organismic morphology and external adaptationism. For example, R. Amundson, referring to P. Alberch, describes a thought experiment to test whether

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[1118] Cf. e.g., D. J. Futuyma, *Evolutionsbiologie* (1986/1990), p. 161 (mainly refering to M. Kimura), also pp. 75, 85, 509.

[1119] Cf. e.g., G. Lauder, *Historical Biology and the Problem of Design* (1982/1998), p. 513. Lauder also points out the necessity of comparisons, but does this, perhaps, in a slightly different way.

and in how far the separation of two species of organisms in morphospace (whose dimensions show in how far certain phenotypic properties x, y, z etc. are expressed) is caused by adaptations to an external environment or by internal constraints. If one were to reduce external selection to a minimum and increased mutation (by mutagens) to a maximum, the strict adaptationist hypothesis would be that the descendent morphologies would tend to be no longer (or much less) clustered, whereas the developmental hypothesis would predict that the clusters would – with certain modifications – roughly stay the same.[1120]

> An acknowledgement of evolutionary side-effects is weaker than the stress on the existence of inner developmental constraints and dynamics in evolution. The concept of properties which are evolutionary side-effects does emphasise that they do not have own causal relevance. They may one day of course become evolutionarily relevant as constraint or adaptation (more correctly: as exaptation[1121]). However, a side-effect without adaptive relevance actually refers to an inner causal necessity and the property itself is in fact not an adaptation, it may even be counter-adaptive. If the formerly adaptive trait perishes and the neutral side-effect continues to exist, one can, only even based on the weak notion of side-effects, argue that traits could exist which neither actually have any adaptive use, nor have had any adaptive use for themselves earlier on. Although still being relatively close to an adaptationist view,[1122] it also, on these grounds, would be wrong to argue that all evolved traits are adaptations.[1123]

As a preliminary conclusion a neglect of the difference between internal and external causes of survival appears to entail a tautological understanding of adaptation. If one instead accepts that the survival of the fittest does not necessarily mean survival of the survivor, but survival of those entities which fit best to a given environment, an adaptationist claim is not tautological any more. For this case it has been shown that adaptation is essential to evolution, but that it is not the only direction giving force. Hence, in this understanding, pan-adaptationism is wrong. It appears that pan-adaptationists actually often waver in their use of the term ‘adaptation’. If concerned with testability they refer to the non tautological fit to an environment and if concerned with its universal validity they refer (implicitly) to the tautological concept of survival of the survivor. Only when based on such a peculiar mixture of argumentations, can pan-adaptationism neither be criticised for being tautological nor for being empirically false.

But we have not reached our final conclusion on this matter yet. I can think of two general objections that pan-adaptationist may raise to the argument I have put forward above.

(1) They might argue that evolutionary theory *should* not primarily be concerned with non-adaptationist explanations, like inner dynamics, chance effects and

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[1120] R. Amundson, *Two Concepts of Constraint* (1994/1998), pp. 96 f. I would add that a moving of still equally existing clusters in morphospace would indicate an internal dynamics.

[1121] S. Gould, E. Vrba, *Exaptation – A Missing Term in the Science of Form* (1982/1998).

[1122] Cf.: E. Sober, *Six Sayings about Adaptationism* (1996/1998), pp. 76-80.

[1123] See: S. Gould, R. Lewontin, *The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme* (1979).

morphological constraints.[1124] But if evolutionary theory limits its investigations to adaptations from the outset and if then adaptation is found to be ubiquitous, then pan-adaptationism is again a mere vacuous tautological truth.

(2) One may argue that the currently used notions of fitness are much more refined than the ones I have treated above and do not lead to a tautological understanding of adaptation, even if one did not adopt the requirement of an increased fit to an external environment. Moreover, if current technical definitions would still lead to tautological results, one could argue that these definitions could be modified in another way to make the claim of the existence of adaptations a non-tautological claim, without thereby directly leading to a refutation of pan-adaptationism. These objections need to be treated in more detail, but finally I shall conclude that my argument above remains largely valid.

Do the existing technical definitions of fitness in evolutionary biology – particularly the ones prefered by gene-Darwinians – prevent a tautological understanding of the 'survival of the fittest', without refering to the internal-external distinction?

(a) After a period of unprecise and speculative use of the term fitness (➲ also p. 347), fitness became to be used in a general way that was designed to show that natural selection always leads to adaption (higher fitness). Fitness – as discussed above – became defined by survival. Also Dawkins concedes, biologists redefined the intuitive term fitness more exactly by "whatever it takes to make the survival of the fittest into a tautology".[1125] One still, of course, had some idea of what adaptation should mean apart from a tautologically empty usage of the term. But this, I think, has either been due to implicitly adopting the above concept of an increased fit to an environment or has been due to specific additional theories on what traits will actually have a high probability of future survival. In any case these existing additional theories where not the core of adaptation as survival always remained the ultimate test for fitness. Understood in this sense, the claim of adaptationism, taken as such, has no predictive value at all and only gains predictive power by other theories with which it is implicitly associated. Despite its intuitively, based on these implicit or additional aspects, adaptation itself, as far as it is understood in this sense, is merely the tautological concept of the survival of the survivor.

(b) Later fitness becomes defined, in a slightly different way, by *reproductive success*, and no longer by the survival of a single organism.[1126] If taken as basis for pan-adaptationism, this, in my view, still carries the burden of the same tautological project. Actually 'survival' had presumably even earlier on never just meant the length of life span, since it would be absurd to assume that only this is optimised in evolution. If this had been the case, the definition would itself not have been tautologically enough in the Dawkinsian sense given above. Natural selection may well lead to a reduction in the life-span if reproductive success is enhanced. To measure the fitness of an organism by its reproductive success seems a more relevant way of repre-

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[1124] See e.g., R. Dawkins, *Universal Darwinism* (1983), p. 404; *The Extended Phenotype* (1982), pp. 29, 32.

[1125] R. Dawkins, *The Extended Phenotype* (1982), p. 182.

[1126] Cf. e.g., R. Dawkins, *Replicator Selection and the Extended Phenotype* (1978), p. 63.

senting survival. But, if fitness "is measured as the number of children born it neglects juvenile mortality and fails to account for parental care. If it is measured as number of offspring reaching reproductive age it neglects variation in reproductive success of the grown offspring. If it is measured as number of grandchildren it neglects.... and so on ad infinitum."[1127] Hence the concept of reproductive success too, if defined in a precise way, is not a strictly appropriate measure of fitness. One still aims at the probability of survival in general. But this general aspect of the term 'fitness', which seems to be its core, leads, without additional qualifications, to an interpretation of adaptation as the 'survival of the survivor'. Post hoc, it is of course possible to determine which organism was fit or which survived, but the general tautological understanding of adaptation is not itself linked to any specific prediction. I think that any definition of fitness which tries to emulate the general concept of survival through the use of another term, remains in the sense given above, at its core tautological.

Nevertheless, a term which is not identical with the term 'survival' is also entangled with non-tautological aspects as well. To define adaptation by reproductive success, assumes the existence of reproductive success, i. e. an evolutionary line and a varying number of descendants. This may even be linked to some central aspects of a Darwinian process, which we discuss below. Nevertheless the core of the concept of adaptation remains in this case the tautological claim of the survival of the survivor – and not an increased fit to an external environment.

(c) The notion of *inclusive fitness* is concerned with survival not only in terms of the number of descendants of an organism, but also in terms which also consider the organism's effects on the reproductive success of its relatives (weighted by their relatedness).

It seems to me that here an additional non-tautological aspect, linked to the concept of kin selection, is introduced besides keeping the generally tautological view of adaptation. A certain claim in regard to the possibility of certain evolutionary mechanisms or of the unit of selection debate is involved in this definition. The concept appears to emphasis the possibility and advantage of mutual help within a kin group. That theory of kin selection is (presumably) a falsifiable theory. But the concept of kin selection has been interpreted in a gene-atomistic,[1128] an individualistic or a group-selectionistic way➲[1035] (➲ pp. 37 f.), and would lead us on to a discussion about what that specific additional non-tautological aspect is involved in our definition.

However, also here fitness is measured by future survival. Now survival, however, is that of the descendants of a particular gene in a certain gene-pool *including* its effect on its copies in other relatives. The still present basic tautological aspect may more easily become apparent if one adopts Orlove's reformulation of Hamilton's 'inclusive fitness'. Orlove has reformulated the inclusive fitness of an organism in a way which does not focus on the organism's effect on its relatives, but on the equivalent effect of relatives on a certain (average) organism. This equivalent reformulation he calls 'personal fitness'. This is the same ordinary reproductive definition of fitness, "but

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[1127] *Idem, The Extended Phenotype* (1982), p. 184.

[1128] *Idem*, *Replicator Selection and the Extended Phenotype* (1978), p. 63

don't forget that this must include the extra offspring he gets as a result of help from his relatives"[1129].

Apart from possible additionally integrated non-tautological aspects, the concept of the survival of the fittest still points generally to the tautological survival of the survivor.

An alternative to such, still at least partly tautological definition of adaptation, would be to define 'fittest' in the sense of its *ordinary meaning*, as the strongest, the quickest and the most intelligent. These 'athletic' common sense meanings may actually have provided the context in which the actual tautology did not become apparent. It is, of course, not tautological to claim that the strongest will survive. Each of these concrete properties we may – or may not – personally value. But besides the problem of priorities of these properties, fitness in this concrete sense obviously does not necessary predict survival: we only have to think of the still living order of amoebae or of the extinct Mesozoic order of dinosaurs. Thus, if one adopted such a concrete definition of fitness, the claim of the survival of the fittest would at least in many cases plainly turn out to be wrong.

> Likewise if one uses the definition of fitness as increased complexity, one can object that bacteria in terms of number are quite predominant. Moreover, such a claim on directed evolution would in any case not resemble the spirit of Darwinism.

Another alternative would be to define fitness in an abstract way by the probability of survival *in the long run*, the long-term probability to survive.[1130] A pan-adaptationism under such a definition of fitness would be much more justified in being called a naturalised analogy to Leibniz's claim that we live in the best of all possible world than the formulations above.➲[1116] For some reasons such a definition of fitness may be useful. But on these grounds the claim of the 'survival of the fittest' would be interpreted in a way that would mean especially those entities survive in the short run, which have the best chances at surviving in the long run. This formulation is not tautological and also appears not to be true, especially in regard to natural selection. Natural selection can in fact, in single cases, lead to long term adaptation. But particularly since natural selection is assumed as being blind towards long term development and as acting instantly, it is not at all guaranteed that those entities survive which will be adapted in the long run. Any extinction of a species after a time of development would be a counter-example to pan-adaptationism. Paradoxically, pan-selectionism appears to be particularly inconsistent with pan-adaptationism.

Moreover, for example, subversion of altruistic co-operative groups by egoistic individuals too leads to the survival of selfish individuals which are less adapted in the long run. This would lead not only to a reduced fitness of the group, but also to a reduced fitness of its average members and even of those now predominant selfish individuals.[1131]

[1129] R. Dawkins, *The Extended Phenotype* (1982), p. 187.

[1130] Cf.: S. Mills, J. Beatty, *The Propensity Interpretation of Fitness* (1979). J. M. Thoday, *Components of Fitness* (1953).

[1131] E. Sober, *What is Evolutionary Altruism* (1988/1998), pp. 463-467. E. Sober, D. S. Wilson, *Philosophical Work on Units of Selection Problem* (1994/1998), pp. 206-207. Also ➲ pp. 284 f.

Hence, also these alternative non-tautological proposals to circumvent a tautology do not lead to pan-selectionism.

But if one does not adopt these alternative definitions, the largely tautological definitions above, likewise seem to have more non-tautological aspects than we have worked out here up until now. Otherwise, it would be implausible that a mere tautological definition could apparently still yield fruitful results.

It is obviously possible and even useful to check, in a *post hoc* way, which entities survived and which did not. Nevertheless, we have also seen that the concept of adaptation, if directly or indirectly defined as the survival of the survivor, does not itself have any predictive power; it could not be exposed to a proper testing and does not itself contribute anything to an explanation. In my view, more specific theories of why organisms or species survive contribute to the missing predictions, but they are *additional* theories. These theories could also be tested.

Also the previously proposed concept of an increased fit to an external environment is a testable assumption (and which is actually sometimes not given). On the other hand the hypothesis that internal factors direct evolution is also testable. But besides these aspects and the already mentioned non-tautological components of the mainly tautological definitions of adaptation, especially additionally adopted theories, in my view render the general – tautological – concept of adaptation as a seemingly testable claim.

Sober, rather critical of the existence of tautological aspects in Darwinian explanations, conceded that although specific adaptive explanations are testable, the general claim that there, in a particular case, exists an adaptive explanation is hard to prove wrong.[1132] This, I think, still somewhat resembles Gould's objection to adaptationism that it is always possible to invent a new "just so story". In my view, the problem of testing adaptationism in general is due to the often implicitly adopted tautological definition of adaptation as the survival of the survivor, which is never ever challenged by any refutation of a specific theory about which entity will probably survive. Only those additional specific theories about what will evolve and survive can be tested. These theories are crucial since we in fact want to predict what traits are evolutionarily stable. Indeed these reasonable specific theories sometimes become falsified as well. For this reason the measurement of, for example, gene-frequencies, numbers of offspring or life spans is central in order to evaluate these theories. But it adds nothing, to call, without qualification, any trait which survives an adaptation. In this sense the actual use of the term 'adaptation' seems to be modified in each case, based on the involved specific theories. Specific hypothesis on evolutionary mechanisms could be tested. General adaptationism could not be tested and does not contribute to an explanation, if adaptation is merely understood as *survival in whatever possible way*.

In conclusion, firstly one may abandon the term adaptation all together, since adaptation in its non-tautological usage is too often entangled with a tautological usage. Secondly, one may keep the notion, as an empty tautological umbrella notion referring to all the traits which according to currently valid and more specific theories are regarded as leading to survival. In this sense pan-adaptationism can not be refuted,

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[1132] E. Sober, *Six Sayings about Adaptation* (1996/1998), p. 81.

since any specific theory, which is shown to be false, is by definition no longer covered by this umbrella notion. In this way of thinking any causes, also internal trends, orthogenesis and chance effects would simply be called adaptations as long as they had some effect on evolution. Thirdly, one may keep the notion of adaptation, but purge it from its tautological aspects. This possibility is advocated here. I have advocated understanding adaptation as an increased *fit to an external environment.* I have shown that this understanding is not tautological. This particular non-tautological understanding has also always been an ideological core of adaptationism, but easily becomes neglected when this understanding proves pan-adaptationism to be wrong – as it does. If adaptationism wants to be taken seriously, I think, it ought to take its own conceptual core seriously itself.

> Nevertheless, it may, for other reasons, be useful to keep the general notion of fitness, defined by survival. It is only wrong to apply this definition to adaptation in a way which leads to the absurd tautological claim of the survival of the survivor. It is of course reasonable and interesting to examine what entities survive or which have a probability to survive, but it is absurd to call any kind of survival adaptation, since then everything is an adaptation. Besides this, we still want to have a language with which to express our more specific hypothesis of which trait will or will not survive, independently of whether it is an internally directed development or an adaptation to an external environment. Also the non-adaptationist hypothesis that an internal dynamic may lead a certain trait (and not to another trait) may be expressed by the short cut that this internal dynamic enhances the fitness of that trait. But in this case an enhanced fitness is not an adaptation to an externally given environment. Here the concept of fitness itself does not contribute anything to the explanation, but is only a short cut for the probability of survival. Of course, any evolutionary entity survives or does not survive. Fitness in its general understanding, only provides a terminology to express our more specific adaptationist or non-adaptationist hypothesis which forces lead to survival, it is in this respect not a theory which can be tested.

Darwin himself, in the period in which he wrote the *Origin,* believed in pan-adaptationism, based only on natural selection and thus in later editions took over the Spencerian slogan of the *survival of the fittest* to characterise his theory. As far as I know he, like many of his followers, did not distinguish between the tautological and the non-tautological aspect of pan-adaptionism. Darwin, although challenging the ontological fixity of natural theology, still stood in Paley's wake with regard to his belief in pan-adaptionism. The term 'natural selection' even mirrors the imagery of God's guiding hand, similar to the 'invisible hand' of another Christian inspired pan-adaptationist, Adam Smith. In Darwin's later period, when his religious belief was shaken (mainly by his own theory), he in the fifth edition of the *Origin* abandoned strict pan-adaptationism and the exclusiveness of natural selection (➲ p. 109). Although it has been to Darwin's merit to see that the simple mechanism of natural selection could in fact lead to *some* adaptation, the strong pan-adaptationist assertion inherent in it becomes highly doubtful if we do not base it on either a tradition of natural theology or interpret the concept of natural selection in a tautological but vacuous way.

c) On the Tautological Basis of Pan-Selectionism

Since selectionism has become universal (➲ pp. 205 f.), I, perhaps with a different intention, have to agree with Dawkins when he says that it "is time to go back to first principles. What really happens in natural selection?" [1133]

Pan-selectionism, which is opposed to approaches which favour the synergetic emergence of processes, normally asserts that besides natural selection – which itself once emerged – no other essentially new types of evolutionary processes ever have emerged. Natural selection is understood as a universally present ontological principle to which all other evolutionary processes can be reduced (➲ pp. 142 f., 209 f.). Natural selection in this view is as basic and exhaustive in respect of processes as elementary particles are to radical supporters of physicalist substance reductionism.

The pan-selectionist claim of process-Darwinism can be formulated as 'all relevant evolutionary processes are processes of natural selection'. This often is formulated in a more specific way as 'all *adaptive* processes are processes of natural selection'. Even so, the two formulations are equivalent providing that pan-selectionists advocate pan-adaptationism as well. If this is so however, then developmental constraints, an internal dynamics or the fixation of traits based on chance, which (as we have seen in the last section) do all not necessarily lead to an adaptation to an external environment, are ignored as limiting the scope of this claim. Tautological pan-adaptationism simply calls these non-adaptive processes adaptations because they also play a role in shaping future existence. Another assumption leading to the mere tautological truth of the equivalence of the two formulations is that one is only interested in adaptive processes anyhow (➲ the preceding section on pan-adaptationism).

Based on an assumed equivalence of (relevant aspects of) evolution and adaptation a pan-selectionist may additionally simply define natural selection as an equivalent to any adaptation. Natural selection would then merely mean that entities survive or do not survive, which is, of course, always true. Such an approach, which by definition regards any evolutionary change, without qualification, as being naturally selected, trivially and tautologically implies pan-selectionism. The proposition 'this evolves by natural selection' would then not be able to make any more predictions than the proposition 'this evolves because of Gods will or because of Providence', since no particular cause or direction is explicitly specified (nevertheless the connotations of these propositions obviously differ considerably). Pan-selectionism, if based on this tautological argumentation, is obviously too absurd to merit closer discussion. Perhaps, no one has ever explicitly promoted this understanding of natural selection, but, presumably, it often plays an implicit role in statements, which in regard to certain properties and without any closer scrutiny of the involved process, assume that these properties evolved by 'natural selection'.

Alternatively, a Darwinian process can still quite broadly, but more appropriately, be defined as being characterised, firstly, by different trials and, secondly, by the existence of a selecting force. Often a Darwinian process, is, as we have already seen, defined

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[1133] R. Dawkins, *Replicator Selection and the Extended Phenotype* (1978), p. 67.

even more strictly. But such a definition from the viewpoint of a pan-selectionist may appear to be able to navigate between the Scylla of being a mere tautology and the Charybdis of obviously proving pan-selectionism to be wrong.

I shall argue that this definition of a Darwinian process is still generally too unspecified. In regard to the first criterion, it is argued that the concept of different trials is almost – although not totally – empty and requires further qualification. The second criterion, the existence of a selecting force, is shown to be a completely empty tautological condition – as long as one does not assign a more specific meaning to this term.

Before I come to discuss the afore mentioned criteria of a Darwinian process, it has to be mentioned that the definition above is still generally so broad that it can be applied to almost any subject area and even to many physical objects. This seems appropriate since we are concerned with universal Darwinism and not necessarily just with biological Darwinism. But universal Darwinism, if not claimed in a tautological way by calling any change as being a Darwinian process, usually limits itself to biological and cultural entities. However, the concept of 'natural selection' has, for example, also been proposed by a known physicist to be applicable with regard to the order of atoms in a laser beam.[1134]

> Let us take another example – single drops of rain – which may appear particularly implausible. A drop of rain is an entity with certain properties such as cohesion etc. The starting point at which a drop is formed can be regarded as a chance process when H_2O molecules come together during condensation (trials). Small drops then evolve, one may say, based on natural selection, due to the density of H_2O molecules in the air etc.

If we would accept that in some cases at least the two criteria (at least in their broad and, as we shall see, almost empty sense) would be fulfilled by merely physical entities, we might still argue that in these cases no inheritance and replication is given.[1135] I, of course, think that inheritance and replication are crucial to biological evolution, since they are preconditions with which past experiences could become accumulated and transferred to the future.

None the less, it should at least be annotated that it is, in my opinion, not entirely trivial that such a necessary additional criterion of inheritance and replication would necessarily exclude all merely physical processes from counting as objects of a Darwinian process.

> Even in regard to a drop of rain, whose order in a way stabilises itself, and one might say 'inherits' its structure to the next moment: the drop although possibly loosing some molecules, collects smaller droplets upon falling. (It is astonishing to learn that there are intensive scientific studies also on the matter of precipitation.) Moreover, it is known that drops which have become very large tend to be broken into smaller drops. Here the macroscopic structure of a drop in a way even duplicates itself. Something like this may cause a domino effect and may play a role when it is raining.

[1134] E.g., H. Haken, *Indeterminismus, Wahl und Freiheit – Wie sind diese Begriffe im Bereich des Anorganischen zu verstehen?* (1984), p. 18. Haken's general theory of synergetics, in my view, still seems rather non-Darwinian since he allows new autonomous self-regulative 'regimes' to govern a situation.

[1135] Cf.: R. Dawkins, *Universal Darwinism* (1983), p. 421.

> Also in more obvious cases of self-organisation in physics something like 'inheritance' seems to be involved. There is a huge field of study concerning non-equilibrium irreversible thermodynamics, a field to which the Nobel laureate I. Prigogine has made considerable contributions. It seems that in this subject area states of macroscopic order come into being by chance fluctuations. These once established states of order in a process of self-organisation again influence the future range of possible fluctuations. One may doubt whether such an inner self-organisational dynamics may violate other criteria of a Darwinian process, which refer to an adaptation to an *external* environment. However, if successive irreversible states of order dependent on each other, this process in a way may be said to have a memory. Also in regard to the physical or chemical evolution of the universe in general, the present structure obviously determines to some extent the future structure. An extended physical notion of inheritance may possibly question whether the biological notion of inheritance is formulated sufficiently general.

Leaving aside the question of whether or not properties in physical processes also are somewhat inherited from former states, we, in any case, add that for a Darwinian process one also requires inheritance.

(1) The criterion of the existence of different trials, although not totally vacuous, is, nevertheless, too broad to represent properly the essence of a Darwinian process.

The concept of different trials – in biology, particularly different mutations, recombinations and speciations – merely excludes the possibility that there is only one possible development or direction. All trials or steps in more than one direction, however directed they may be, would then qualify as being parts of Darwinian processes. Instead of one determined direction a Darwinian process requires a probability function of trials with different directions.

This criterion is not completely empty, since processes which really only produce steps in one direction are excluded from being Darwinian processes. This aspect of a definition would indeed exclude historical pure Lamarckism from being a Darwinian process, because in a purely Lamarckian process each adaptive step is assumed to be a 'trial' in one adaptive direction, which is directly informed by the environment. This shows the non-tautological aspect of this definition without leading to a refutation of pan-selectionism, since radical biological Lamarckism – besides some open questions (➲ pp. 148, 313 f.) – largely has to count as having been refuted.

But according to this definition, all semi-directed processes would count as Darwinian processes as well. Likewise, all evolutionary inner constraints, if still allowing at least two minimally different directions, would be counted as natural selection. The concept of constraints on variation leading only to precisely one possible direction, is, admittedly, a concept, which can be thought of, but since all morphological processes are rather fussy, this would at best be approximated by the actual facts. None the less, I think we do want to distinguish between more or less directed processes.

In the cultural area, which, according to process-Darwinians, is also exclusively describable by Darwinian processes, it is simpler to find a counter example even for the very cautious definition of pan-selectionism given above. For instance, the possibly directly correct response to a mathematical problem, not known to the solver before, would, at least on the level of the individual, obviously not be a Darwinian process.[1136]

> One may object that internally, cognitively, there has perhaps still been a production of a broad variety of proposals. Firstly, this would be a hypothesis which is not proven at all and which even seems difficult to test. Secondly, such a general perspective seems to neglect the particular properties of different forms of exploration, here of rational reasoning. Thirdly, even if on some basic level there indeed were a broad variation of trials, this would provide us with an example of a processual synergetic whole, since the level of the individual is directed in any case. This interpretation would confirm process emergentism, by showing that the combination of Darwinian processes, does not lead to another Darwinian process itself, but may, for example, gain properties of directed evolution.

But also in regard to this example the criterion of 'trials' in any case seems not to differentiate appropriately between different processes. In problem solving it does not only make a difference whether we directly solve problems or not, but also how many trials we need or how directed the process of solving the problem is.

The criterion of different trials defines a Darwinian process so broadly that processes which are partly directed would simply be counted as Darwinian processes. Pan-selectionism is not claimed in a strictly tautological way, but reinterprets almost all counter-evidence that suggests it is still close to a tautology. Hence a stricter definition appears to be needed.

(a) Directed non-adaptive variation. Developmentally constrained variation may only lead to evolutionary products which are not optimally adapted.[1137] If the range of variation is so narrow that no proper adaptation can be achieved one may not regard it as a proper Darwinian process.

Developmentally constrained variation can in my view partly be interpreted as a form of auto-selection, which in any case will be shown to be non-Darwinian as well. Somewhat differently, Amundson, for example, interprets all developmental constraints as constraints on variation and I agree that they may play a role. If, for example, mutations are always interpreted along the predominant established developmental pathways, certain phenotypic variation – and we are of course concerned with phenotypic properties – will, at least probabilistically, not occur. In regard of an evolutionary line as a whole, one can in both cases speak anyway of *variational* constraints.

> Whales, mammals which earlier lived on land, are in many respects adapted to spending their whole life cycle in water. For example, the broad horizontal tail flukes which provide the main propulsive thrust bear no anatomical connection to the lost hind limbs. Nevertheless, whales still have, for example, lungs and have not evolved secondary gills to breath air resolved in water, which possibly would have been advantageous for their deep dives. This may be interpreted either to be due to the developmental pathway making such a mutation

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[1136] One may object that here the basic information is already given by the axioms of logic. Nevertheless it obviously requires in some sense a 'new' knowledge to solve new mathematical problems. In this regard I tend to follow Kant in regarding complex mathematical judgements as synthetic judgements apriori.

[1137] Confer also in section (b) the treatment of the necessary range of variation, ➲ p. 355 f.

highly improbable, or because any mutation in this direction in an auto-selective way turned out to be disadvantageous.

The difficulty, but necessity, of distinguishing between an internally caused direction and adaptation to an external environment has been discussed before (➲ pp. 343 f.). This has been shown to be particularly important in preventing a mere tautological understanding of adaptation.

Amundson, as mentioned above, exposes an interesting proposal about how to distinguish what features of given populations are due to internal constraints on variation and to adaptation to an external environment.[1138]

(b) Directed adaptive variation. With regard to adaptations, I think, we should distinguish between cases where a blind vast abundance of trials is needed for an adaptation and cases where an adaptation may be possibly achieved in a more directed way.

It appears reasonable to require for our definition that the trials of a Darwinian process are blind, as has actually been assumed by the majority of neo-Darwinians.[1139] Trials are blind if no trial has an enhanced probability for being adaptive, relative to other actual or hypothetical trials.[1140] The probability function of the different trials causing changes should not correlate with their adaptability.

The strict blindness of a trial could be interpreted as radical *antithesis to inductivism*. Blindness assumes that former experiences, former adaptations, do not improve the probability of solving new problems in the future. Dawkins' in *Universal Darwinism*, argued – on a generally anti-inductivist basis – that Darwinism "is probably the only theory that *can* adequately account for the phenomena that we associate with life"[1141] Elsewhere he states, that "Darwinism is the only known theory that is in principle capable of explaining certain aspects of life. If I am right it means that, even if there were no actual evidence in favour of the Darwinian theory (there is, of course) we should still be justified in preferring it over all rival theories"[1142]. "The 'Darwinian world-view' is not only the theory which happens to be true, but it is the only theory which is possibly explaining our existence"[1143] (➲ pp. 209 f.).

Although we aimed at making our definition of a Darwinian process more testable by requiring trials to be blind, at this point another tautology seems easily to creep in if one pleads for pan-Darwinism based on an assumed refutation of inductivism. I have argued before that anti-inductivism can simply be based on a trivial tautological truth: one does not know what one does not know (➲ pp. 210 f.). If this were the claim of the inductivists they would of course simply be wrong. I have argued earlier, that this has never been upheld by inductivists. Inductivists argue that old knowledge has a certain enhanced probability to be valid in new situations. We are entitled to think that the sun will rise tomorrow as well. This is the claim that our knowledge has a higher probability than a chance guess of also being valid tomorrow, although the world may have changed. Also if situations change an inductivist may either argue that we are directly informed by the environment or, in a less

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[1138] R. Amundson, *Two Concepts of Constraint* (1994/1998), esp. p. 108, ➲ footnote 1120.

[1139] Including most proponents of the evolutionary synthesis and of gene-Darwinism, also ➲ footnote 1173. Darwin himself had still allowed directed adaptations, even based on an explicitly Lamarckian mechanism, ➲ pp. 106 f.

[1140] ➲ also e.g., footnote 1174.

[1141] R. Dawkins, *Universal Darwinism* (1983), p. 403.

[1142] *Idem, The Blind Watchmaker* (1986/1991), p. 287.

[1143] *Ibid*, p. xiv.

> radical way, that we may to some extent be able to skilfully rearrange our knowledge so that the resulting generalisations, transformations etc. have normally a higher probability of being right than mere chance guesses. The question is not whether the unknown could be known (of course not), but, whether former knowledge in its generalisations and other transformations could also – on average – have any validity in new situations.
>
> In evolutionary theory the question is whether variation (mutation, recombination etc.) is always necessarily blind whether, earlier adaptations, newly combined have a higher probability of being adaptive, than completely chance trials. Of course here an aspect of chance is necessarily involved. The question is whether all trials really in principle have to be assumed to be completely blind. Linked to this discussion is the question of whether an evolutionary line of a species could appropriately be said to be less blind in finding an adaptive optimum than a line of asexual organisms. If biological or cultural processes of knowledge acquisition could be speeded up, we would presumably not call them all equally blind, at least not on the level of the focused whole.
>
> Since I have discussed anti-inductivism earlier on and argued against an *a priori* refutation of inductivism, we here continue with the assumption that the blindness of trials is not *a priori* given, but a matter of empirical investigation (➲ pp. 212 f.).

If blindness could be assumed, but the Darwinian process should still lead to adaptation, an *abundance of trials and a certain range of their variation* appears to be required. If the range of variation or the number of trials is small, either the assumption of adaptation or of blindness would have to be abandoned. With a very limited number and range of blind trials it is not guarantied that in a given adaptive landscape within a reasonable amount of time even a close adaptive optimum will be found. Alternatively, if adaptation is assumed to have taken place, only a few trials with a limited range of variation leading to that adaptation, would not properly be regarded as blind and more variation in non-adaptive directions as well would have needed to occur in order to sustain the assumption of blindness. Hence, if we do not want to abandon adaptation or blindness of trials as essential aspects of a Darwinian process, a certain range and number of trials appears also to be required.

Hence for a comparison of different theories on evolution the amount of claimed variation seems to qualify as a yardstick as to just how Darwinian they are. We may, for example, think of two theories of language evolution, one of which claims the elimination of a vast number of populations with different language structures which in turn, led to the existing language structure, other of which claims only very few eliminations. Whatever position one holds on this matter (I am personally not committed to any position on this specific dispute), it appears to be reasonable to distinguish these theories according to where natural selection is 'doing more work'.[1144] A theory which assumes that only a few trials have led to the evolution of a property either implies that the trials have somehow been directed towards this adaptation or that the trials, if they are assumed to be blind, have probably not reached a very adaptive result. It would in my view be absurd to claim alternatively that, for instance, Chomsky, advocating a minor role for blind trials and for external elimination, basically supports the same theory as someone who pleads for its omnipresent role.

[1144] Cf.: E. Sober, *Six Sayings about Adaptation* (1996/1998), p. 78.

In spite of this Sober, pointed out that in respect to a given observed variation it is difficult or even impossible to judge how far this variation is directed towards an adaptation, since there are no fixed standards for how broad variation has to be.[1145]

> It should be noted that this is not only a problem for the critics of Darwinism but equally for Darwinism itself. If not solved, it would mean that any possible empirical evidence for directed variation would become excluded, not empirically but theoretically. Moreover it would equally be possible to regard all processes as directed, because one could also always think of a larger range of variation. Directionalism and Darwinism were in danger becoming mere matters of opinion, not of empirical evidence.

Although I agree with Sober that there is a difficulty since no strict general standards are available, this does not mean that we cannot make any distinctions. In regard to specific traits we may well think of a sufficiently broad variation of blind trials leading to a certain adaptation. We are definitely concerned with a question of degree, but in a specific context may still determine whether the range and the number of blind trials will probably lead to an adaptation in a given time. This becomes particularly apparent in regard of alternative hypotheses, like in those of language acquisition above. It would be wrong to call both in an equal way Darwinian.

In regard to directed adaptive variation, we can generally conclude that we require blindness as a criterion for a Darwinian process and not only different trials. Moreover, it appears reasonable – although remaining slightly more problematic – to require that the trials are also abundant and varying enough if it is another precondition that they should lead to adaptation.

(2) The second criterion proposed for a Darwinian process – the existence of a selecting force – represents, if taken as such, not a substantial assertion at all. Without a more restricted use of the term ‘selector’ this criterion is vacuous. If a selector, differing from the original connotation of the word, is broadly understood as *all* external *and* internal conditions under which an entity is formed, then simply all conditions and causes which lead to its existence are meant. If possible non-adaptive inner constraints or an inner dynamics are also taken as selectors then selectors are by definition always given, since simply any cause is meant. If any explanation is defined to fulfil this criterion of a Darwinian process, the claim of its universal validity is tautological and vacuous. (Cf. the problem of the definition of adaptation, ➲ pp. 339 f.).

An alternative, which would not make this criterion of pan-selectionism a mere tautology, would be to define the selecting force as being external. This is actually often done and it is only this that also guarantees that selection leads to an adaptation to an external environment.

Given this, internal developmental constraints leading to a certain evolutionary direction would, appropriately, not be interpreted as being Darwinian processes (➲ pp. 343 f.). An external selector is also absent in regard to the dispersion of genetic neutral genes or to genetic drift, and hence these processes also, as it is often argued, would not fulfil this criterion of a Darwinian process. (Drift, however, may sometimes play a role in the variational step of a Darwinian process on the population level.)

[1145] *Idid*, p. 79.

Likewise, what I have called systemic individual ‘selection’ (➲ pp. 291 f.) is, on the level of the system, not a Darwinian process. Here internally a Darwinian process leads to the adaptation (in the afore outlined non-tautological sense) of organisms to other organisms belonging to that system. Even so the system as a whole has gained a certain independence from external selectors and, as such, the direction of evolution is not necessarily adaptive but determined by the inner dynamics of this system. Hence, the system as a whole is not ruled by a Darwinian process. This is, I think, a good example of the synergetic properties of compound processes, in which in regard to processes a whole is not merely the sum of its parts (➲ pp. 394, 409).Hence, if a selector is defined more appropriately as being external, this criterion of the pan-adaptationist claim, is not tautological any more – but often false.

Conclusion. If simply identified with pan-adaptationism, pan-selectionism is fully tautological and merely claims the survival of the fittest in the sense of the survival of the survivor (➲ previous section).

Another seemingly much more differentiated way of defining a Darwinian process is to define it as a process of trial and selection. I argue that this is in fact no longer tautological, yet still close to a tautology.

First, the criterion of trials, strictly understood, only completely excludes directed stages of evolution. All processes with a minimal variation would fulfil this criterion, even if we are either concerned with a strong internally constrained variation not-leading to adaptation or with an adaptively directed variation which very quickly leads to an adaptation. Hence, processes which are appropriately called non-Darwinian, because they do not lead to an adaptation at all, or because they are directed towards adaptation, would absurdly still count in favour of Darwinism. Also in accordance with the generally strict neo-Darwinian understanding of a Darwinian process, I argue that a stricter criterion for a Darwinian process is required: trials have to be blind; there should be no enhanced probability that they lead to adaptation. Moreover, there should be no strong constraints on this blind variation if we want to assume that these blind trials lead to adaptation.

Secondly, the criterion for the existence of a selecting force is vacuous, if understood so broadly that any cause and condition, whether internal or external, can be taken as such force. Since any entity has internal and external conditions of existence, a claim that there is a selecting force only refers to the trivial fact that there are some explanations for the existence of an entity. This is, of course, true, but vacuous. If internal constraints and internal tendencies not leading to adaptations were also all called selecting forces, since they are causally relevant and thereby contribute to the survival of a particular kind of entity, then this criterion would be, of course, universally fulfilled – without saying anything. I argue that the second criterion for a Darwinian process has thus to be understood as selection by an environment. This aspect of a refined non-tautological definition is also in accordance with the core of the Darwinian tradition. Processes based on an inner dynamics which are not leading to an adaptation, could then not be redefined as Darwinian processes. I have pointed to some examples which prove pan-selectionism to be wrong. In the next section the resulting definition of Darwinism and its alternatives will be discussed.

9.2 Re-defining the Notions of Darwinism and Lamarckism

a) A Strict Definition of Darwinism

From the universal application of Darwinism[1146] and from the last two sections on its tautological aspects it is apparent that a strict definition of Darwinism is needed which is not tautological but which aims at a conceptual resolution that distinguishes different types of processes in the physical, biological and cultural spheres as effectively as possible. Aiming at a conceptual resolution is something like an *a priori* condition (roughly in the Kantian sense) to make process emergentism visible. If we believe in the existence of the evolution of evolutionary processes, the probability of detecting such an evolution will be higher the more strictly we formulate our definition of Darwinian processes.

Still in accordance with the normal use of the notion, but strictly excluding its possible tautological or semi-tautological aspects that were discussed before, I define a – pure – Darwinian process as follows.

(0) The basis for a Darwinian process has to be a direct continuous line of descent and heredity, which preserves information. (1a) The first step of a Darwinian process is signified by a diversification or variation of informational lines. (1b) That variation of the informational line is completely blind. Moreover, variation should be abundant and broad enough that relatively close adaptive optima can be found. (2) The second step of a Darwinian process is external selection leading to adaptation in respect of a temporally given environment.

A Darwinian process as a whole leads to the survival of those blindly produced entities, which are most opportunistically adapted to their momentaneous environment.

Proposition zero is normally uncontroversial, and is accepted by most critics.[1147] The other propositions also boil down only to a stricter formulation of our working definition, which is widely accepted (➲ pp. 102 f.). However, it also becomes apparent that tautological formulations of Darwinian processes too may often have helped to immunise the Darwinian paradigm and, equally, that a stricter definition may challenge pan-adaptationism and pan-selectionism (➲ pp. 339 f.). Despite the resemblance to our working definition, the definition is now more precise and we have aquired certainty about the essential role of the components of the definition. The most important aspects of the definition above can be summarised in the following phrase,

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[1146] ➲ pp. 205 f. Cf. e.g., K. Shrader-Frechette, *Should Epistemologists Take Darwin Seriously?* (1990).

[1147] Nevertheless, in a way, this aspect has also been challenged here as being an exclusively valid description of evolution. The concept of an informational line has been complemented by the concept of exformation. Although the storage of exformation is itself partly based on the information of another evolutionary line, it has been stressed above that certain features of one species may, in a way, be stored in another co-evolving species. (➲ The concept of external memory, pp. 326 f.)

which I already occasionally have used earlier in this work.[1148] A Darwinian process is a process of blind variation (1) and external selection (2).

This conceptualisation is also historically appropriate in respect to modern Darwinism. Modern Darwinism is a synthesis of Darwin's externalism and Mendel's belief in the internal factors of evolutionary variation.[1149] But the evolutionary synthesis transformed the originally anti-Darwinian Mendelian and mutationist contribution, so to speak, in a way that was radically Darwinian: the internal force of variation, was now understood to be a completely undirected, blind force, producing random material on which natural selection could work. The Darwinian evolutionary process is generally described as "genetic chance and environmental necessity".[1150] Likewise Mayr regards modern Darwinism in essence as a synthesis of mutationism (in the sense of random events or accidents) and externalism.[1151]

> Although it may have been the originally intended consequence of Darwinism to explain *progress*,[1152] I suppose that Darwin's believe in progress became shattered by his own theory (➲ pp. 112 f.). At least based on the modern strict definition of Darwinism, progress is not at all an essential aspect of that theory. Bowler similarly argued that "Darwinism does not really guarantee progress or at least makes it very difficult to define."[1153] Particularly gene-Darwinism is clearly opposed to any progressive interpretation of evolution.[1154] Also Gould adequately stressed that from the viewpoint of Darwinism, understood as the negation of innate progression and as adaptation only to present and local environments "we are glorious accidents of an unpredictable process with no drive to complexity."[1155]

In the section which directly follows I propose to regard regarding Darwinism, defined in the strict way that I previously elaborated, as one extreme of a spectrum of approaches. In the subsequent sub-sections different aspects of this definition will be clarified and discussed separately in detail. In addition to our earlier discussion of pan-adaptationism and pan-selectionism this will lead to a critical evaluation of the universality of Darwinian processes.

b) A Spectrum between Darwinism and Lamarckism

Darwinism has, sometimes been understood only negatively by the absence of a strictly Lamarckian type of evolution. If one accepts such a negative definition, Darwinism seems to gain strength because of the weakness of radical Lamarckism. All middle positions then would simply count in favour of Darwinism, which would then wrongly mostly still be associated with the implications of Darwinism in the strict sense.

For another reason such a negative definition of Darwinism via Lamarckism is problematic. The term 'Lamarckism' leads to a preoccupation with Lamarck's

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[1148] This appears to resemble Campbell's terminology, but in the second aspect voluntarily differs from his formulation.

[1149] R. C. Lewontin, *Gene, Organism, Environment* (1983), pp. 273 f.

[1150] E.g., E. O. Wilson, *On Human Nature* (1978/1995), p. 1.

[1151] E. Mayr, *Animal Species and Evolution* (1963), pp. 1-2.

[1152] R. Richards, *The Meaning of Evolution* (1992), pp. 89-90.

[1153] P. J. Bowler, *Evolution* (1984), p. 310 (refering to Simpson and other authors), cf. pp. 315-316.

[1154] G. C. Williams, *Adaptation and Natural Selection* (1966), pp. 4, 34, 22 f., 34 f., 42 f, 47 etc.

[1155] S. J. Gould, *Full House* (1996), p. 216, quoted in M. Ruse, *The Mystery of Mysteries* (1999), pp. 146.

alternative theory of aquired characters only, which, in regard to biology – with some reservations – has to count as having been refuted (➲ pp. 311 f.). In regard to the blindness of evolution Lamarckism might still represent an extreme antithesis to Darwinism although only less radical theories may appear possible today. Darwinism, however, was also opposed by different theories. Lamarck's original theory (➲ also pp. 90 f.) even resembles Darwinism in understanding evolution as a process of adaptation to an externally given environment. Lamarckism stressed that organisms "take their fate into their own hands"[1156] only in respect of the directedness of trials. Nevertheless, Lamarckism was originally an essentially adaptationist approach. But Darwinism has not only been criticised for the concept of the blindness of trials, but also for being – like Lamarckism – a theory which stresses adaptation to an external environment. Pre-Darwinian and post-Darwinian idealists or romantic biologists, until today, have stressed the internally directed unfolding of forms (➲ also pp. 95 f., 156 f.). Also today's criticism of adaptationism, in my view, still partly follows – albeit often only implicitly – in this wake. Other critics of adaptationism stress that chance processes, like drift and neutral mutations, not directly controlled by any survival value, play an important role in evolution. Another kind of criticism of Darwinian adaptationism – although closely resembling a Darwinian argumentation – is found in my proposal that self-referential systems of selection, could acquire some autonomy from adaptation to an external environment (➲ pp. 291 f., 394 f.). In any case, Lamarckism, if used as an antithesis to Darwinism conceals the fact that criticism of Darwinism is not confined to Lamarckism in its narrow sense, but itself even sometimes differs considerably from Lamarckism.

However, I am not aware of a more appropriate notion designating all approaches to evolution that are less blind, but more directed and internally governed. Presumably, it would be correct to use the purely negative term 'non-Darwinism'. In the headline of this section I have kept the misunderstandable, but well known, positive term 'Lamarckism' which is meant here in its broad sense. The broad usage is actually found in the later nineteenth century, where 'Lamarckism' often referred generally to theories which advocated a less blind and more progressive evolution, orthogenesis and inner trends included.[1157] Although Lamarckism in the narrow sense has been confined to the inheritance of acquired characteristics, it has only been one aspect of these non-Darwinian or anti-Darwinian approaches. Lamarckians in a broad sense generally favoured a more directed and internally governed form of evolution than Darwinism, and in principle do not need to be considered Lamarckians in the strict sense at all. However, one may choose a different term that would be less easily misunderstood to cover the different non-Darwinian theories. Here I am mainly concerned with developing the concept that Darwinism in our strict definition should be understood as one extreme of a spectrum of theories.

[1156] D. J. Depew, B. Weber, *Darwinism Evolving* (1995), p. 45.

[1157] Cf. e.g., P. J. Bowler, *Charles Darwin* (1990), p. 21; *The Non-Darwinian Revolution* (1988), pp. 99-103. (Bowler himself, as already the title of the latter book indicates, prefers to use Lamarckism in the narrow sense.)

From a Darwinian starting point, it appears reasonable to define a non-Darwinian antithesis with regard to the two components of the above definition of Darwinism, i.e. blind variation and external selection. This does not result in only *one* spectrum, but in *two* spectra or rather one spectrum with two dimensions.[1158] One dimension reaches from blindness to the directedness of trials, the other reaches from stress on increasing fit with an external environment to stress on internal, for example developmental, dynamics (Figure 11).

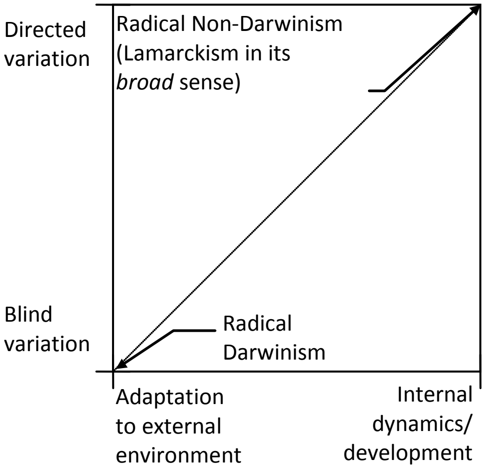

Figure 11: Visualisation of the two-dimensional spectrum of Darwinian and non-Darwinian theories

The *first dimension* contrasts blindness versus directedness. Darwinism, in the above sense, is characterised by the blindness of trials, which – if linked to adaptationism – requires a wasteful abundance of trials if they were to lead to adaptation (➲ pp. 354 f.). Strict Lamarckism *in the narrow sense* – which is also an adaptive process – would compose the other extreme only on this dimension (upper *left* corner of the figure), since for each evolutionary step only one trial is needed, because it is directly informed by the environment. Approaches which neither support strictly blind trials nor direct informedness by the environment could be more appropriately located somewhere in between these radical poles. Likewise, approaches, of course, which concede a role to both aspects would be located between theses poles. Darwin himself was partly Lamarckian (➲ pp. 106 f.), and neo-Lamarckians came to accept Darwinian concepts. But although strict Lamarckism – in regard to biology – has to be taken as having been largely refuted, an approach which showed that variation is itself adapted and could be more or less blind (without upholding Lamarckian omniscience) would also be in contradiction to strict Darwinism as defined by our above understanding. Furthermore, a theory would differ from strict Darwinism, if it stressed that processes which themselves may be described in a Darwinian way could lead on another level of synergetic wholes, which are less blind.

I shall argue below, that even in the biological stratum – although they are more obvious in the cultural stratum – mechanisms can gain a certain ‘sight’. In this sense none of the radical positions, be it Darwinism or Lamarckism, appears to me to be true. I do not want to deny the role of chance. Blindness and wastefulness play an important role in evolution. (Even authors like Aristotle admitted the existence of

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[1158] This should not imply that these dimensions in regard of a particular theory were completely independent.

chance.[1159]) But in a certain sense I dare to argue that even in the field of biology the blindness of processes can be reduced. This becomes even more apparent with respect to culture. Universal Darwinism is wrong to stress the unchangeability of blindness and wastefulness. I shall propose that it appears possible and appropriate to reinterpret the given evolutionary facts in such a way, that variation is neither omniscient nor necessarily completely blind.

The *second dimension* in Figure 11 represents approaches to evolution which understand evolution as an adaptation to an external environment in contrast to those which stress an internal unfolding. In short a contrast between externalism and internalism. The externalism of Darwinism becomes apparent by the very word selection – a selector being normally regarded to be external to the entity which becomes selected. The whole Darwinian stress on adaptation to a certain environment is linked to this externalism (➲ pp. 339 f., 350 f). A. N. Severtsov, who himself was an influential Russian Darwinian, places Darwinism together with Lamarckism on the side of external causes, ectogenesis, and opposes them to autogenesis.[1160] Also Mayr contrasts Darwinism with theories advocating changes from intrinsic forces.➲[1151] This dimension corresponds to the traditional alternative of whether the evolving entity is regarded as the subject or the object of evolution.[1161]

I have argued above and I shall argue in the further course of this chapter that internal dynamics not only constrains evolution, but that inner dynamics can gain some autonomy from external selection (➲ pp. 291 f., 339 f., 394 f.).

In the following sections I shall neither advocate strict Lamarckism nor strict internal developmentalism, but shall oppose the universality and unchangeability of the Darwinian blind, wasteful and externally imposed mechanism of evolution. The position I want to contribute to appears to be located somewhere in the middle of the two dimensions shown in Figure 11. Although this would be the best approximation for localising my position, it would still misrepresent it, since I argue that the process itself evolves and hence its properties vary along both mentioned dimensions according to the focused evolutionary line. I am even inclined to argue that there may be an overall tendency away from blind externally governed evolution towards seeing internally governed evolution, but this lies beyond the scope of this work. Since actual evolutionary processes will never be 'omnicient' there will always be cases where the process itself becomes less seeing. A different interpretation of the understanding of evolution favoured here would stress the full openness of evolution in regard to processes also. This is equally consistent with my argumentation put forward in this work. Here I more generally argue that the Darwinian stress on universality, unchangeable blindness and externality of evolution is misconceived.

[1159] Aristotle. *Physics*, II, VI, p. 197 b, but see also p. 198 a.

[1160] M. B. Adams, *Severtsov and Schmalhausen.* In: E. Mayr, W. Provine, *The Evolutionary Synthesis* (1980), pp. 193 f.

[1161] Cf.: K. Bayertz, *Autonomie und Biologie* (1993), p. 346. M. Weingarten, *Organismen – Objekte oder Subjekte der Evolution?* (1993).

Although I am concerned with universal process-Darwinism in general – also at the cultural level –, I confine myself in the following discussion mainly to *biological* Darwinism, which is the paradigm case for Darwinian evolution. Instead of trying to build another protective dike in the cultural sciences against the rising Darwinian flood,[1162] I mainly try to tackle this flood at source.

In the remaining sections, it is, of course, not possible to provide a full genealogy of evolutionary processes. Instead the inappropriateness of universal process Darwinism will be shown and some alternative proposals which may contribute towards a more evolutionary theory of evolution are made.

9.3 Toward Radical Evolutionism – The Evolution of Evolutionary Mechanisms

Subsequently I shall show more systematically that, if we apply the above definition of a Darwinian process to existing processes, it becomes doubtful that evolution on all its different explanatory levels could appropriately be described by a Darwinian process alone.[1163]

It will be argued that even in the biotic stratum it becomes necessary to accept at least limited evolution of evolutionary mechanisms. Early critics of Darwinism, from scientists to theologians, although wrong in many respects, may have, to some extent, been right in their critical stance towards what Herschel, astronomer and predominant philosopher of science in Darwin's times, called the "higgledy-piggledy" mechanism of natural selection. A Darwinian process, in the strict sense set out above of course can lead to *some* adaptation. (Logically it is presumably the simplest process which does this.) We have seen that the concept of a simple replicator even entails the concept of a chance process of natural selection. This may be accepted as a starting point, but I argue that evolutionary processes come into play which are less wasteful and externally governed in the same way that I have argued that single genes become organised and unified into more complex systems of organisation, which have their own synergetic properties. More complex entities, on some explanatory level, may also involve the existence of more complex and less blind and externally governed evolutionary mechanisms. Although I, of course, do not deny the millions of years of evolution, I agree with the old criticism that if blind-variation-and-external-selection had remained the *exclusive* mechanism of evolution, the velocity of biotic evolution and then, even more so, of cultural evolution could not be properly explained.

Based on our strict non-tautological definition of natural selection, the pointed proposition of G. C. Williams that "the laws of physical science plus natural selection can furnish a complete explanation for any biological phenomenon"[1164] will be challenged. Such views, which are also claimed to include the cultural sphere as well (➲ pp. 209 f.), still mirror aspects of a Newtonian-Platonic *Weltanschauung*, although Darwinism has forcefully undermined other aspects of these philosophies. As far as

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[1162] Described by: D. Dennett, *Darwin's Dangerous Idea* (1995), pp. 64 f.

[1163] Cf. also the results of section 9.1 on pan-adaptationism and pan-selectionism, ➲ pp. 336 f.

[1164] G. C. Williams, *Adaptation and Natural Selection* (1966), pp. 6-7.

Darwinism is concerned, there still is only one type of process of evolution, natural selection, which is regarded to be externally and eternally given, although physics too has started to stress the unfolding of the universe as well as of its inner forces and laws (➲ also pp. 168 f.). Although drawing strongly upon Darwinism myself, I think the time has come to transcend the Newtonian-Platonic static understanding of process, particularly because its only concern with the very simplest process of evolution one can think of, and to transform our evolutionary theories in a way in which they become coherent with a more truly evolutionary world-view.

In the following sections, based on the definition of a Darwinian process above, I start from within the Darwinian paradigm. Firstly the phenomenon of diversification is contrasted with the phenomenon of synthesis. Secondly, blind variation is contrasted with directed variation – at least on certain levels of explanation. Thirdly, the concept of hetero-selection, characteristic for Darwinian adaptationism, is contrasted to the phenomena of auto-selection, which may lead to a certain amount of autonomy. Finally, Kant's concept of self-referentiality is discussed as a possible criterion for the autonomy of processes.

a) Synthesis versus Pure Diversification of Information –
Discussion of the First Criterion for a Darwinian Process

A Darwinian process 'is signified by the diversification or variation of informational lines.' This is one defining aspect of our strict definition of a Darwinian process, given above. The conceptual core of Darwinism only predicts the diversification of evolutionary lines, not their synthesis (cf. Figure 12). This is associated with the picture of a branching and diversifying evolutionary tree. In order to differentiate strictly between Darwinian aspects of evolution and non-Darwinian ones, we apply this widely accepted aspect of definition in a strict way. This may be considered unusual, because one is usually concerned with finding explanations rather than answering meticulous questions of delineation involved in differentiating different evolutionary paradigms. Another reason for the neglect of this topic is that, perhaps, the beauty of unified pan-Darwinism has rendered a less strict application – leading to fewer problems – more suitable.

In respect to *physical processes* we can exclude some processes from classified as Darwinian due to this aspect of the definition. Planets, for example, – like drops of water (➲ p. 351) – may in fact be said to have a probability curve indicating where the mass concentrations will unify in order to form a larger planet, depending on the general density concentrations of interstellar mass. This physical process resembles a Darwinian process in regard to the existence of the necessary variation of the starting points and different 'trials' of unification. Moreover, one may also, perhaps, speak of external conditions for the emergence and further accumulation of mass concentrations. However, this process differs from a Darwinian process particularly in the sense that the 'evolutionary lines' (mass concentrations) do not diverge, but rather converge. Instead of a multiplication of such lines, one could more reasonably speak of a synthesis of different mass concentrations: different concentrations of interstellar mass unite at the place of their gravitational centre. In this respect a process like this is diametrically opposed to a Darwinian process, whose emphasis is on the diversification of evolutionary lines (and elimination of those which are less adapted to a given environment).

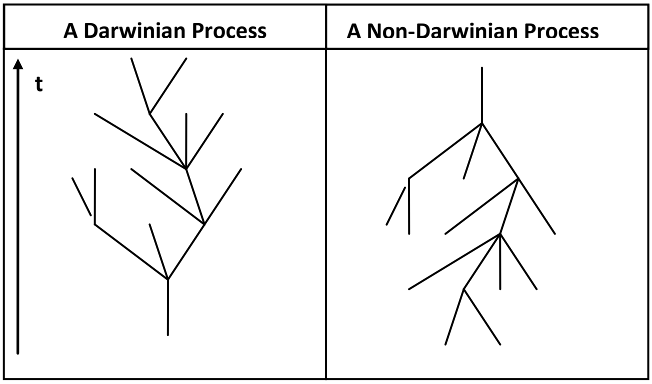

Figure 12: Visualisation of the diversification of informational lines, one criterion of a Darwinian process.

Despite the claims of universal Darwinism, *cultural evolution* cannot, I think, in regard to the criterion discussed in this section, be described by exclusively Darwinian processes.

As biological-cultural integral wholes, humans can obviously acquire some experiences and transfer them to other humans. On such a level of explanation, evolution, if including culture, is in part radically Lamarckian, since acquired knowledge could be transferred to offspring, and, of course, also even to unrelated organisms.

But promoters of process-Darwinism (➲ p. 216) – which in its consequences is less radical, compared with gene-Darwinism – do not normally take the perspective of human biological-cultural wholes. They hold that thoughts, theories and cultural habits, what I have called '*logoi*' (➲ p. 57), gain a life on their own, which has to be dealt with separately. According to process-Darwinism these entities are competing with each other and their evolution is to be described by Darwinian processes.

I also support the view that *logoi* have to some extent a life of their own. But, this in my view does not have to entail the belief that the biological-cultural human as a whole does not exist and can not provide proper unit of investigation. The interaction of these two independently existing levels is crucial for both. Hence, the perspective on the biological-cultural whole of a human is both possible and suitable. But within this perspective one has to acknowledge the strictly Lamarckian aspects of culture. Furthermore, even if one accepted that one always – not only for specific reasonable purposes – has to disentangle biological and cultural levels, cultural knowledge itself is not adequately describable by Darwinian processes alone.[1165] Here the criterion for differentiation versus synthesis is focused – whereas other equally problematic criteria, such as the blindness of trials, are left aside. If one traces some units of cultural development, for example concepts or symbols, throughout intellectual history (the daily bread of any historian of thought) it appears that diversification, which obviously plays a vital role, is balanced by the synthesis of different meanings.[1166] Especially in a connectionist understanding of the cortical functions of the brain it becomes plausible that representations of different concepts are not independent from each other, but influence each other and even may melt into each other.

Likewise, theories and schools of thought diversify and compete with one another, but they may also influence and improve each other, and may even melt and develop a common synthesis. The most important intellectual triumphs appear to be the syntheses of views which were previously regarded as being opposed to one another – Mendelian genetics and Darwin's original theory provide an example of such a synthesis.[1167]

Furthermore different cultures are also strongly interwoven. One may, for instance, think of the fact that the occidental philosophical heritage of Greek Antiquity was preserved and partly developed by philosophers of the Arab world.

Hence, it appears to me that on all levels of cultural evolution diversification is complemented by synthesis.

Similarly in *biological evolution* Darwinism has stressed the diversification of evolutionary lines and their differential survival. The only diagram in Darwin's *Origin* illustrates the branching character of the tree of descent, without any synthesis.[1168] This concept appears to be valid at least in respect to the level of species. This is almost true by definition, because today species are normally defined by the absence of any interbreeding. However, in 1994 S. Bartl, D. Baltimore and I. Weissman have influentially argued that through viral infection genes appear to be transmitted between what are normally regarded as species.[1169] One may also argue that what I have called 'external memory', in a way involves a synthesis of common effects of different organisms (➲ pp. 326 f.).

But one does not need to trouble oneself with such, perhaps, rather specific or peculiar points, since the obvious process of *biological sexuality* involves the unification of organismic informational lines. It may appear senseless to criticise Darwinism

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[1165] Cf. generally: D. Holdcroft, H. Lewis, *Memes, Minds and Evolution* (2000).

[1166] Even some supporters of Process Darwinism doubt whether cultural evolution could adequately be described as a Darwinian process in its strict sense. E.g., H. Plotkin, *Darwin Machines and the Nature of Knowledge* (1994), pp. 220 f.

[1167] As mentioned earlier, this may not be a good example of a synthesis which has been balanced, since the 'evolutionary synthesis' may in some respects be regarded as a purification of the Darwinian paradigm. Also Darwin's theory itself is in the present work described as a Malthusian synthesis of romantic and Newtonian thought (➲ p. 162).

[1168] Ch. Darwin, *Origin of Species* (1859/1868), pp. 160-161.

[1169] Cf. also: E. J. Steele, R. A. Lindley, R. V. Blanden, *Lamarck's Signature* (1998), pp. 168 f. D. J. Futuyma, *Evolutionsbiologie* (1986/1990), pp. 79, 541-542.

based on a process of which all Darwinians have been aware and which has even been at the very core of the evolutionary synthesis (itself at least largely Darwinian). But generally, it is not impossible to use aspects of a theory against itself. In this way Darwinism incorporated previously-opposed Mendelism. If we take my (non-idiosyncratic) definition of a Darwinian process seriously, it turns out that the synthetic aspect of sexuality is not Darwinian at all. Diversification, opposed to synthesis, is anyhow normally regarded as an essential aspect of Darwinism,[1170] but even if this were not the case we set out to find a particularly strict definition of a specifically Darwinian process. Although sexuality also serves the proliferation of varying descendants – being perfectly compatible with Darwinian views –, the synthetic process equally involved here is itself not a predicted or essential part of Darwinism. Dawkins is in my view right about Darwinism in general, when he argues that, fundamentally, "all that we have a right to expect from our theory is a battleground of replicators".[1171] If one does more than to pay lip service to the definition above, the replicational and variational aspect of sexuality at once becomes Darwinian and the role of synthesis entangled with these forms of variation is no longer describable as a Darwinian process.

A true entity reductionist would object that biological sexuality is *not* a true synthesis in any case, and hence no truly new mechanism has come into being. Genes – as we have known since Mendel – do *not* blend. In regard to single genetic elements this is correct, they are genotypically not themselves altered in a physical way during sexuality. If one were only to focus on single genes, there would be no true syntheses – although one may object in this case that the genetic context, as we have seen, also changes the interpretation of single genes (cf: *epistasis*). But I have argued previously at detail that in my view it is not adequate to regard single genes only as units of evolution (➲ pp. 264 f.). In a more holistic interpretation organisms that sexually reproduce are biologically a *synthesis* of the different genomes of their parents (and their current environmental conditions). In that synthesis genes have a certain, slightly changed phenotypic expression. (If the new whole did not somewhat influence the interpretation of the parts, the genic features from the mother and the father would not normally fit together.) Only if the synthesis is harmonious enough, will the resulting organism have the chance to reproduce. The variation aspect, the reproduction aspect, and the survival aspect of sexual reproduction are easily linked to Darwinism. But the aspect of synthesis itself, is, as mentioned above, not itself part of a Darwinian process.

The specific aspect of synthesis in sexual reproduction is, if we keep the above strict definition of a Darwinian process in mind, not only thoroughly opposed to a Darwinian process, but may also be linked with non-Darwinian consequences. The trials in sexual reproduction could be said to be less blind than mutations. Although it is possible that the genes of the parent generation do not harmonise with each other, they are, one may say, pre-selected. In a roughly similar genetic context the genes were tried out during the life of the parents and many other combinations will have been

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[1170] ➲ pp. 102, 358 f., also footnote 1173.

[1171] R. Dawkins, *The Selfish Gene* (1989), p. 256.

'tested' before in the population. Although proponents of the evolutionary synthesis may have expressed this fact differently, the apparent differences to mutations, led them to regard recombination as an evolutionary factor in its own right (➲ pp. 130 f., 378 f.). Moreover, the evolutionary line is now broader than one organism, and rather becomes an evolutionary river of one basic population or gene-pool into which all changes are flowing back.[➲597] If combinations of advantageous mutations are a limiting factor and populations are large enough, a population with synthesis (as part of sexuality) will on average find advantageous combinations of mutant genes faster than asexual populations can.[1172] Based on synthesis new forms of inner organisation also become possible, for example some mechanisms which I shall later call 'auto-selection', which in regard of a system as a whole not necessarily lead to an adaptation to an externally given environment.

If one accepts explanatory levels higher than that of single genes, sexuality does not only involve proliferation but also, in a rather non-Darwinian way, synthesis. This also leads to the situation in which populations are not necessarily closed entities, but on some level of description may also melt their best – or worst – features.

b) Directed Variation versus Blind Variation – Discussion of the Second Criterion

'The variation of the informational line is completely blind'. This is the next criterion of our strict definition of a Darwinian process. It is a criterion that is largely accepted. A Darwinian process is normally regarded as being composed of the two steps of variation and selection[➲371], the first of which – which is scrutinised here – is regarded as being completely blind or random.[1173]

Campbell has pointed out that the word 'blind' should be preferred to the more usual 'random', because equiprobability is not needed – and is actually often not given. But the criterion of blindness nevertheless requires that variations are produced without prior knowledge of how adaptive they will probably turn out to be. Moreover, their occurrence is assumed to be independent of environmental conditions. No trial should be more likely than another one to be correct, and later trials should not make use of the direction of the previous ones.[1174] Thus Campbell has described a

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[1172] D. J. Futuyma, *Evolutionsbiologie* (1990/86), pp. 317 f. (referring partly to J. F. Crow, M. Kimura, 1965).

[1173] D. T. Campbell, *Evolutionary Epistemology* (1994), pp. 421-422. R. Dawkins, *The Extended Phenotype* (1982/1989), p. 168. D. Dennett, *Darwin's Dangerous Idea* (1995), p. 59. N. Eldredge, *Reinventing Darwin* (1995/1996), p. 133. D. J. Futuyma, *Evolutionsbiologie* (1986/1990), pp. 49, 86 (but e.g., 522). E. Mayr, *Evolution and the Diversity of Life* (1978/1079), pp. 16-20, 204. J. Monod, *Le hasard et la nécessité* (1970/1991), p. 110. K. R. Popper, *Objective Knowledge* (1972/1979), p. 270. But cf. also: M. J. S. Hodge, *Darwin's General Biological Theorizing* (1983), pp. 57-58.

[1174] D. T. Campbell, *Evolutionary Epistemology* (1994), pp. 421-422. Almost word-for-word the same text: D. T. Campbell, *Blind Variation and Selective Retention in Creative Thought as in Other Knowledge Processes* (1987/1960), p. 91; *Evolutionary Epistemology* (1974), p. 421. Similarly Dawkins, ➲ footnote 1217. Campbell, however, considers the possibility of "shortcuts", which I rather regard as a violation of the strictest understanding of Darwinian process, linked to the concept of the unchangeable blindness of evolution.

Darwinian process generally as a process of “blind-variation-and-selective-retention”.➲[864]

To define Darwinism in such a way contrasts Darwinism with more directed and predictable approaches to evolution.[1175] It is assumed that variation does not ‘see’ what will be positive for the survival of the entity in question; in this sense Dawkins uses the phrase the ‘blind watchmaker’.[1176] If a Darwinian process were to guarantee adaptation, the blindness of variation would require an abundance and wastefulness of trials (➲ e. g. pp. 355 f.).

Universal Darwinism (➲ pp. 205 f.) claims that Darwinian processes are the only relevant evolutionary processes. In its more moderate version of process Darwinism (➲ pp. 216 f.), which accepts cultural entities, this blindness should equally hold for different types of biological variation like, for instance, psychological variation or the variation of theories. In this section I mainly focus on the discussion of variation in the biotic sphere.

> I think it is disputable to rest the burden of proof one-sidedly on the view that there is directed variation. Despite my objections to pan-adaptationism (➲ pp. 339 f.), Darwinians (as Lamarckians and other adaptationists) no doubt have shown that adaptation plays an important role in evolution, and it is hence implausible to assume that adaptation plays no role in improving the trials of evolutionary mechanisms themselves.

An often repeated general argument for the implausibility of an unchanged blindness of evolutionary processes has been that the *limited time span* to produce the multitude of different complex organisms. Historically the period of time for evolution was estimated incorrectly as being much shorter as we know it to be today. This point was used to render Darwinism absurd (e. g. Lord Kelvin). None the less, this argument may appear to contain a core of truth, particularly if unchangeable blindness is taken in a strict sense, and likewise if the present estimations of the time of the origin of life are taken as a basis for it.

> The following argument follows an early, but in principle still applicable, calculation of G. G. Simpson which has been re-interpreted by some critics of Darwinism as showing the implausibility of a strict blindness of trials. Simpson assumes, strongly simplifying, a general mutation rate of 0.000 01. (Simpson makes some additional assumptions which slightly change the outcome of the calculation but are not important for the line of argument.) The probability for only five simultaneous mutations in five specific genes according to Simpson’s calculations is not larger than 0.000 000 000 000 000 000 000 1. Such an event in 100 million individuals with a generation period of only one day will on average take place every 274 billion years. But according to the present scientific estimations the first organic life arose about 3 or 4 billion years ago. Hence, given the complete unchangeable blindness of this process, it appears very improbable that such an event (in regard of certain specified genes) will have taken place only once in a species of the above parameters.[1177]

[1175] E.g., P. Bowler, *Darwin.* (1990), pp. 155-156, 160-161.

[1176] R. Dawkins, *The Blind Watchmaker* (1986/1991), pp. 306 f.

[1177] Ch. v. Guttenbergm, *Biologie als Weltanschauung* (1967), p. 42. Very similar R. Nachtwey, *Der Irrweg des Darwinismus* (1959), pp. 79-80. Recently, this old argument has been used in the intelligent design debate: W. A. Dembski, *Intelligent Design* (1999). But confer also the objections in E. Sober, *Evidence and Evolution* (2008).

> One may object that evolution has found natural ways in which mutations have an enhanced probability of being phenotypically expressed together. The fact that many mutations for a time remain silent if they are part of long undecoded strands of DNA (introns) allows variation to spread by drift also, if the mutations would not be advantageous outside a certain combination (when they would be transcribed). The mutations which have not appeared at the same time, but successively, by a, as we shall see, relatively frequent mutation of switching on a certain peace of genetic code, causally appear together. Moreover, sexuality and recombination in particular leads, as mentioned, to a quicker evolution by combining (earlier tested) mutations from different organisms with one another (➲ e. g.: pp. 336 f.; 364 f., 378 f.).
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> But such arguments need not to be taken as a defence of Darwinism. In contrast, they are close to the point I want to make. I am also looking for 'natural' evolutionary explanations. But if the tempo and mode of evolution has actually changed systematically, enabling a quicker adaptation, it may be possible to reinterpret this as a change in the evolutionary process itself, a change involving the production of variation which, perhaps, on some level may suitably be said to have become less blind.

Here the orthodox neo-Darwinian view is challenged that evolution was and is unchangeably blind. Since I shall not advocate something like radical biological Lamarckism, this criticism is based on the assumption that there are not just two poles in the theoretical debate, but a whole spectrum of approaches on the dimension of blindness versus directedness of variation (➲ pp. 358 f.).

The trial aspect of Darwinism has been discussed before in the section on the tautological basis of pan-selectionism (➲ pp. 350 f.). In it I have already elaborated the possibility of developmentally constrained variance (➲ p. 353) and of a lacking abundance of variance. This is also inconsistent with Darwinism, but rather on the other dimension of our definition of our two-dimensional spectrum of Darwinism and non-Darwinism (➲ p. 355, pp. 359 f.). Here we are more concerned with the possibility of adaptively directed variation which has been mentioned as well. I am concerned with a re-interpretation of given evolutionary and genetic mechanisms in a way that some adapted mechanisms, may systematically produce trials with a higher probability of leading to survival. Instead of the fitness of the organism, a certain variation producing mechanism could in my view be fit as well, and enhance the probability of producing varying organisms with comparatively good chances to survive.

> Although most examples will be concerned with directed adaptive variation, the aspect of an adaptation to an external environment and the inner dynamics is here particularly difficult to disentangle, because they often go in the same direction. However, we are here concerned with the aspect of blindness and this blindness is in my view by some mechanisms in any case apparently reduced.

Since I am advocating a spectrum of approaches, an alternative to radical Darwinism does not necessarily entail a violation of the Weismann doctrine in the sense required for radical Lamarckism.[1178] Nevertheless, I advocate that several evolutionary mechanisms have evolved which on some appropriate levels of explanation render the

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[1178] Such a dichotomy also often implicitly appears to be assumed by normally highly differentiated writers, from whom I very much draw in more specific respects. E.g., D. J. Futuyma, *Evolutionsbiologie* (1986/86), p. 86 (but e. g. 522).

average trials less blind. Whether this is logically possible is closely linked to our understanding of explanatory levels and particularly of change, newness and induction (➲ pp. 371 f.). I do not challenge any commonly acknowledged empirical 'facts', but only their interpretation in Darwinian evolutionary biology. One may either regard the point I make as a daring interpretative shift or as an almost trivial plausible truth. My re-interpretation of long acknowledged facts is based on the strict definition of Darwinism given above (➲ pp. 358 f.) and the elaborated multi-level account of evolution (➲ pp. 264 f.). It draws strongly from findings from the rapidly developing field of microbiology (➲ generally pp. 147 f.).

Firstly, it is discussed, whether trials should be regarded as being blind by definition, based on a certain understanding of newness. Secondly, different types of variation are distinguished, like mutation, genetic recombination and specification. This appears to follow from a multi-level account of evolution. Thirdly, we come to the main point in which it is shown that not all variation appears to be equally blind. Some processes producing evolutionary variation seem, themselves, to be adaptations leading to trials which, on average, have a higher fitness than they would have on the basis of pure chance. Although evolution may have started in a purely Darwinian way, it appears not always to have remained strictly blind. Fourthly, some cases will be mentioned where one may, perhaps, additionally speak of a particular kind of adapted variation as a direct response to an environment (without necessitating a violation of the Weismann barrier).

(i) Not Blind by Definition

It appears possible that biological or cultural knowledge is blind simply by definition, because evolutionary trials explore changed conditions and change might be defined as the totally unknown and something which cannot be seen in advance. This problem has been discussed above under the keyword of the problem of induction (➲ pp. 210 f., also p. 354). Here I am not particularly interested in the direct transfer of information from the outer to the inner, since I do not promote radical Lamarckism. Instead I am concerned with the more original question, of whether knowledge could in principle have any predictive power, since the 'reality' to which knowledge refers – if knowledge is referential at all – may always have changed.

I should also like to shortly examine the first question of a *direct information transfer*. To some extent I share the critical attitude of process-Darwinism towards inductivism as direct information transfer, even on the level of psychology and sociology. As equally held by constructivists and idealists knowledge is in my view at least in some respects based on an elaboration of prior existing (biological, psychological or social) knowledge.

All the same, a radical blindness also in this sense and a radical denial of bottom-up processes appears to be one-sided. Psychologically we are for example apparently able to 'see' things about which we had no particular hypothesis before. (Here seeing could equally be understood literary and figuratively for other ways of perception.) If such phenomena are conceded, obviously bottom-up processes take place, otherwise one would not be able to see, for example, an unexpected candle placed on the table.

A process-Darwinist and any other anti-inductivist, may have two objections against this argument. Firstly, an anti-inductivist may claim that this openness to see an unexpected candle is a result of former (biological and cultural) trial-and-error learning. As a result, it is absurdly claimed that one, in a way, has the permanent hypothesis that candles could be on the table. The ability of sight itself is regarded in the usual simplifying parlance to be a product of natural selection. Sight includes the ability to detect entities of roughly the size, density, wavelength etc. But even if this is conceded, nonetheless, our perceptive capacities have a remarkable openness to see objects, which did not exist earlier in evolutionary history or in our individual biography of learning. We may actually perceive something like a candle, even if we had not encountered a specific candle before (we ourselves and any of our predecessors). This apparent openness to new forms and combinations obviously transcends the earlier experiences we have made. In this sense inductivism seems to be right.

Secondly, an anti-inductivist may object that there are still trial processes – possibly blind trial processes – on lower levels, fluctuations of attention, receptivity of our retina or our neural system. Such aspects, of course, exist, but the question is whether there are synthetic bottom-up aspects as well. On some level of explanation there are apparently bottom-up processes, for instance the causation of a nerve impulse is controlled by the light density on a certain area of the retina.

Moreover, even if this were not so, it has been argued above that nested levels of blind Darwinian processes could be organised in a way which still allow for a broad openness on a higher level of explanation. In this interpretation the whole is not blind even if its parts are. The concept of synergetic properties on higher levels of explanation has previously been discussed in respect to processes, for example, in regard to biological specification (➲ pp. 336 f.). Such an approach would, I think, not correspond to pan-Darwinism, but rather to a process-emergentist viewpoint, which nevertheless largely draws from the concept of processual Darwinian 'atoms'.

Hence, even if it would be correct to evaluate the inductivist aspect of a direct information transfer critically in the two outlined ways, I hope to have shown that the inductivist equally makes a valid point. Hence also in the respect to information transfer, it appears plausible to me that neither inductivism nor non-inductivism are generally valid alone.

The question which I am mainly interested in here, is the more original question of induction, concerned with the possibility of prediction, which is here applied in a biological context. Hume's problem was that 'all inferences from experience suppose, as their foundation, that the future will resemble the past'. It appears to me that some proponents of universal Darwinism base their claim of a universal blindness of trials on a supposed negative 'solution' to the problem of induction. They argue that prediction, which compared with chance guesses has an enhanced probability of being right, is, strictly speaking, not possible at all.[1179] This 'solution' has generally been critically discussed before in this work (➲ pp. 212 f.).

With respect to biology it is often ignored that this problem would not only affect changes in an evolutionary line, like mutations, but also evolutionary stability. Actually any concept of fitness, any survival and identical replication of an organism would be affected by this problem! Argued the other way round, the very survival of organisms and their unchanged replicas proves already a certain stability of the (external) world. It is apparent that replication of formerly advantageous properties often brings an advantage for the future. If this were not the case not only would pan-adaptationism be wrong, but the concept of adaptation would be completely without any foundation. Whether this should be regarded as referring to a probabilistic logic of induction or rather to the factual advantage of such a heuristic, in any case the existence of a

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[1179] R. Dawkins. *Universal Darwinism* (1983). ➲ pp. 209 (see also Popper).

minimal stability of the world, which Hume doubted, is supported on these grounds. On the other hand obviously fallibilism was right in stressing that old knowledge could always turn out to be wrong; induction never has, of course, the security of deduction (➲ also pp. 339 f.).

Despite this parallel the question of the possible probabilistic advantageous use of old knowledge in regard to evolutionary *change* is more difficult. One can, I think, in this respect easily commit the fallacy of claiming blindness on tautological grounds only. If change is defined as the unknown and the unpredictable, then it is by definition true that no aspect of change can be predicted and that every trial to reach an understanding of this change is necessarily completely blind. But such a definition does not face what is actually controversial, rather it simply excludes any alternative view from being possible in our semantic framework. The very question is, whether change is actually completely unpredictable and whether old knowledge can help us in facing the changed world by reapplying the old in a changed way. Change, does not necessarily imply unpredictable change. There may be a certain stability in the first derivation of existence (in change) as in existence itself. There can be stability in the change of knowledge itself, which may systematically enhance the probability of a correspondence with the external world (relative to mere chance changes). This could firstly be the case if there are continuities in environmental change to which internal change has become adapted. Other possibilities are internal continuities of change, which are particularly advantageous when facing external change, because they do not need a continuous external dimension or direction of change. We may think of building blocks which have turned out to be particularly advantageous in quite different situations. A trial based on such building blocks and containing a higher probability than a chance process of producing a system which fits a changed environment, could not properly be said to be just as blind as chance guesses. On the view expounded here, the question of whether variation is completely blind or not is not a logical, but an empirical one. Are there adaptive continuities in biology and has evolution developed mechanisms which make use of possible internal or external adaptive continuities?

Change still mostly contains an unpredictable component, even more than stability itself does. However, I shall argue in the following sections that evolutionary change does not always mean change to the totally unknown. Trials are never as certain as being completely externally informed or as deductions, but trials are neither blind by definition nor are they actually always blind. We could think of continuities of change, and we may think of changes which have a higher probability of being adaptive than blind chance trials. I shall argue, in a quite Darwinian way, that those evolutionary lines with a higher probability to produce trials which have an enhanced probability to lead to a higher fitness than mere chance trials, have themselves a higher chance of surviving. If one speaks of organisms with an increased probability of surviving, one may also speak of mechanisms which have an increased probability of leading to the survival of an evolutionary line (particularly since I have previously defended a multi-level account of evolution). A certain amount of continuity in the changes of the organism-organism or the organisms-environment interaction, has – as we will see – been shown to be advantageous by evolution. Although a certain degree of blindness always remains, the trials are not equally blind throughout. But this empirical question is the topic of the next sections.

Humean scepticism and the Darwinian concept of blindness are, in my view, right in their fallibilism, which stresses that empirical knowledge, both biologically and culturally, could never reach absolute certainty. But even so I think the metaphysical dichotomy of blindness versus certainty conceals the possible degrees of sight and short-sightedness. Advanced internal model construction, which is still fallible, is not the same as simple blind trial-and-error learning.

In this section I have argued that we cannot judge *a priori* that biological change is always equally blind, but that this has to be investigated empirically. Elsewhere I have provided a more thoroughly treatment of Hume's fundamental problem of induction.[1180]

In the broader cultural context, which as we have seen also seems to have influenced the evolutionary synthesis (➲ pp. 188 f.), I think H. Putnam is right: "The idea that correct ideas just come from the sky, while the methods for testing them are highly rigid and predetermined, is one of the worst legacies of the Vienna Circle."[1181]

(ii) Different Types of Variation

Because Darwinian processes are characterised by the blindness of variation of an informational line, we should take a closer view at the phenomena described as variation, before we come to discuss whether empirically they always appear to be blind.

Here variation means changes in an evolutionary line, and not in what one may call 'stable variation'. Stable variation refers to given unchanged distributions of genes as expressed in the Hardy-Weinberg equation. This does not mean that all continuities of change are excluded because, as set forth above, this resulted in claiming the blindness of trials in a tautological way. Yet stable variations, and not stabilities in change itself, correspond on the population level to an identical replication of genes on the level of genes or individuals and is part of the statics rather than the dynamics of evolution. We are hence concerned with any evolutionary change – opposed to identical reproduction – which still possibly includes continuities of change itself (preferred dimensions or directions of change).

There are different types of such variation. The most prominent and basic class of evolutionary changes are mutations. There are simple point mutations (mutations of single base pairs), but also more complex mutations like inversions, translocations, frameshift mutations or mutations in which the whole genome is restructured.

> I shall argue that some particularly complex mutations may often make systematic use of structures evolved earlier and can often be said to be systematically less blind than mere chance.

Alternatively, genetic cross-over and recombination do not lead to new sequences of base pairs at a certain locus, but only to new combinations of such base pairs.

[1180] M. von Sydow, *Testing Descriptive or Prescriptive Conditionals and Differential Effects of Frequency Information* (2007), Chater 3.

[1181] H. Putnam. *The 'Corroboration' of Theories* (1974), p. 238.

Nevertheless, new combinations also have to be blind to count as being a Darwinian process.

I have already indicated above that I regard these trials as less blind, because they are somewhat pre-selected. Although they lead to new combinations, they are tested beforehand in a similar context. Moreover, mate choice may enhance the probability of certain new combinations, even if the places where cross-overs happen were random. This is discussed in the next section.

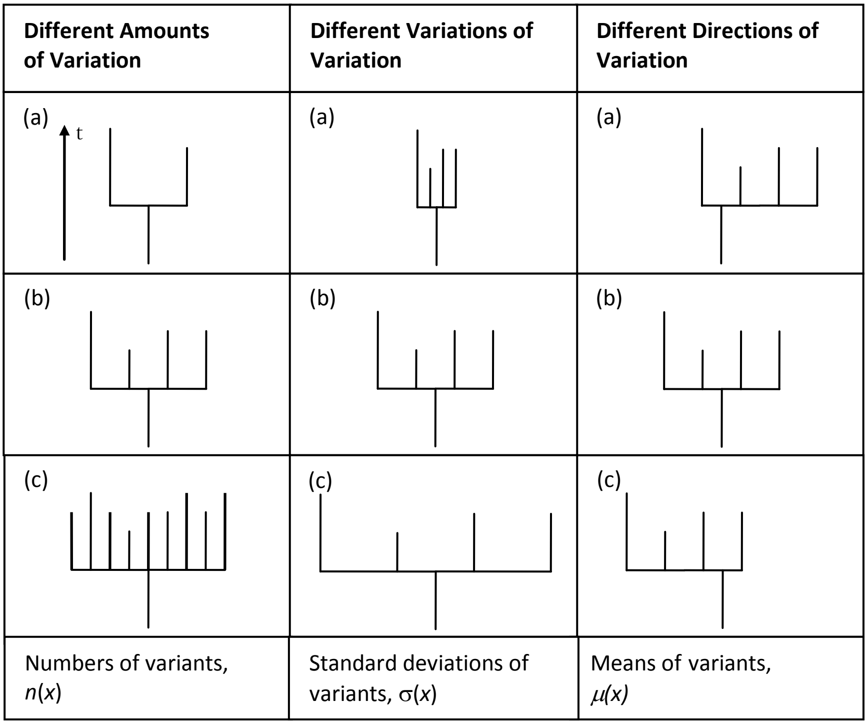

Figure 13: Simplified visualisation of types of variation of informational lines or their phenotypic expression. (Here we are only concerned with variation in the sense of evolutionary change.) In the diagram only *one* generation of reproductive entities (e. g. complex genes, organisms or species) is shown. The vertical dimension in each diagram is time. The horizontal dimension is something like genetic difference or, differently, distance in the morphospace. Although making some distinctions, naturally, this visualisation still makes simplifying assumptions. In regard to species it could, for example, be disputed if the genotypic variance were to emerge suddenly, which is indicated by the sharp edged corners of the trees. Also the emergence of new lines does not need to take place only when old lines have declined.

If multi-level Darwinism, which is defended above (➲ pp. 264 f., 152 f.), is to be taken seriously, specification also has to be regarded as a factor producing evolutionary variance in its own right.

> I have mentioned already that specification may not necessarily be blind. Besides the possibility of adaptive speciation rates, there may be a pre-selection on the level of individuals or sub-populations, so that specification, on the defended level of the species, may well not be totally blind. This has been discussed before (➲ pp. 336 f.) and we will also touch on this topic in the next section.

In a truly multi-level account one may also think of other levels of variation, like the level of groups or the level of ecosystems. But for reasons of simplicity this is not elaborated in the following section.

> Tendencies in the process of group formation determine what genetic combinations will actually have newly been tested at the group level. There are presumably mechanisms with which a group is formed at least in 'higher' animals, which may systematically enhance the fitness of the group. If this were the case then variation would not be blind. I have discussed, for example, the very simple mechanism of the influence of a – perhaps partly inherited – average group size on the stability of certain genetic combinations which are advantageous to groups. One may well think of the possibility that the average group size itself is a product of group selection, which leads to a stabilisation of this group structure and favours group selection (➲ pp. 284 f.). In this case groups would vary in a way which is particularly adaptive for these groups and not blind in the most radical sense.

Independent of the level at which variation takes place, evolutionary change can have different characteristics. We can distinguish, for instance, the average amount of variants, the average difference of the variants in relation to the reproducing entity, and the average specific direction of variation. In a diagram of different evolutionary trees these types of variation can be visualised (see Figure 13).

These possible characteristics of variation are actually partly quantified by biological measures. The *amount of variation* of organisms or genes is usually gauged by their general or specific mutation rate as well as by their recombination rates. In regard to species the same is measured by the general speciation rate.[1182] The average *difference of variants* and the *direction of variation* (column two and three) are normally not actually assessed, but they are in principle given by the distribution between how new genotypes or phenotypes differ from the old ones.

With our distinctions between the different types of variation made, the stage is set to discuss whether it is reasonable to regard evolutionary variation as a result of blind chance. Firstly, I discuss whether aspects of the actual variation can be regarded as adaptations rather than as the direct results of blind chance (we are concerned with all three columns). Secondly, I briefly consider, whether some variations could possibly be interpreted as occurring systematically even as a particular reaction to certain environmental conditions.

[1182] Indirectly also the individual birth, death rate and extinction rate play a role here.

(iii) Is There Adaptive Variation?

There seem to be different classes of cases where one, using a fine grained terminology, wants to speak of particularly adaptive variation. We are interested in variation which is systematically less blind than the production of trials, exclusively based on chance, even if the central dogma of microbiology (in its most constrained sense) is not violated. I distinguish here between two types of *adaptive* variation.

(1) In a multi-level account of evolution, which has been supported above (➲ pp. 152 f., 264 f.), there may be interactions between different evolving levels which may render the variance on a certain level less blind. For example in speciation the variance on the species level of newly evolved species, may be directed by the earlier selection process on the level of individuals or sub-populations. Even if the variance at the individual level were completely blind, the species level, which we have argued exists as well, is not necessarily equally blind. One may argue that only blind processes count as true evolutionary processes, but this again makes the claim of blindness a mere tautology. If one accepts many evolutionary levels it may well be that selection processes can be arranged in such a way that blindness is reduced on a certain level of explanation, that may even provide the reason for why a particular multi-level arrangement has turned out to be evolutionarily more stable. Moreover, as argued before, synthetic aspects playing a role on the species level may reduce the blindness (➲ p. 367). Previously I also discussed two sub-classes of interactions between selection processes, multi-level selection and nested selection, which may both lead to an adaptively directed variation (➲ p. 336 f.). However, in both sub-classes adaptive variation relies on a selection process at another level, without itself necessarily being blind. These forms of directed variation are flexible in their response to a certain environment. They do not need, like the next class, to assume a certain stability inherent in the evolutionary change itself.

(2) Some dimensions or directions of change may on average be more advantageous than totally blind trials. In this section I argue that internal molecular structures and sometimes macroscopic morphology provides evidence that a repetition of already existing structures was often more advantageous than the production of completely new structures by single steps. There are preferred building blocks, dimensions of change and sometimes, perhaps, even directions of change, themselves partly the result of adaptation. A recycling of old structures, equal to that in the class above, both refers to a previous selection process and to the empirical fact that the use of these *particular continuities* often – but not always – has turned out to be more adaptive than mere chance combinations. If such arguments are admissible, then one can no longer claim blindness in a tautological way (➲ p. 371). I do not, of course, deny that most changes (particularly mutations) are still harmful,[1183] but I think the building of a complex structure from scratch without 'recycling' pre-selected structures would normally require many more harmful steps. In this sense it is reasonable to speak of

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[1183] D. J. Futuyma. *Evolutionsbiologie* (1990/1990), pp. 69, 76.

comparatively less wasteful and more directed trials. Certainly, it is never certain whether a particular dimension or tendency of preferred change will not become disadvantageous, in the same way as that any adaptation may one day turn out to be no longer adaptive. In such a case a tendency may even constrain possible adaptation and in this sense adaptive tendencies – although being for a certain time less blind – will remain short sighted. In any case, the facts from microbiology, as we shall see, indicate that preferred dimensions and directions of change have played a role in evolution and can often be regarded as adaptations. Such tendencies have allowed for an often much quicker evolution than one would otherwise think possible, on the basis of totally blind mutations alone. Opposed to the class of directed adaptations, which were firstly dealt with, here a *stable* fitness increasing dimension or direction of change is needed. This is either due to external continuities or internal building blocks, which are particularly advantageous in many different contexts.

It is not always easy to distinguish between these two classes, because in both cases some sort of pre-selection takes place and because these classes of a more directed variation are in principle applicable to most of the mentioned levels on which evolution can take place.

Speciation, which is described at the species level, may be directed because of a pre-selection at the level of sub-populations (class 1). But one can also think of a regular and itself adapted speciation rate (class 2). It is actually known that different evolutionary lines have different speciation rates,[1184] and it is possible – although the object of a vigorous debate – that speciation rates (or even more radically also specification directions) may themselves be the object of adaptation at the species level. One might, for example, explain the actual differences in the production of evolutionary change in generalists or specialists in such terms.[1185]

I now clarify the two possible classes of directed variation in respect to *genetic recombination* of sexual reproduction and crossing-over.

(a) Recombination is indeed *largely random* in the sense that alleles at a locus coming from both parents are normally mixed in a purely random way, so that both have an equal 50% probability of being included in a certain sperm or egg cell. This randomness is a key presumption of the Hardy-Weinberg equation, itself pivotal to population genetics. It has also been proposed that the adaptedness of sexual recombination would break down if its randomness were not secured.[1186] Nevertheless there are actually cases of so-called segregation distortion or meiotic drive which violate this random mixing and are, perhaps, best explained by selfish DNA.[1187] However, I do not question that, apart from such exceptions, sexual reproduction in this respect is generally largely random.

[1184] E.g., mentioned in: N. Eldredge, *Reinventing Darwin* (1995), p. 120.

[1185] Instead this is often explained exclusively by E. S. Vrba's so called 'effect hypothesis'. *Ibid*, p. 139.

[1186] R. Dawkins, *The Selfish Gene* (1989, added chapters), pp. 264 f. Although Dawkins presumably also regards this aspect as gene-Darwinian, it appears to me that the benefit of the whole evolutionary line may equally be regarded to be the cause for the existence of the randomness. This refers back to the discussion of the levels of evolution ➲ pp. 264 f.

[1187] R. Dawkins, *The Selfish Gene* (1989), pp. 235-37; *The Extended Phenotype* (1981/1989), pp. 133 f.

(b) Even so in an important and, I think, often neglected respect, the blindness of recombination is reduced. Here I am referring to the *first class of directed adaptive variation* above. Recombination only recombines genes which have previously existed at the same gene locus and survived. More radically mutations create new base pair sequences at a given locus. However, recombination, as argued above, is a kind of trial in combining genes. Interaction effects of new combinations are tested, which might have never been tested before. At least on the level of what I have called 'higher-level genes' (➲ pp. 267 f.) new genes are formed. Such trials still involve the risk that some gene combinations may prevent the building of a coherent organism. Nonetheless these trials only use material which has been tested before on another level. Thereby the risk involved in the new trials is reduced. Although recombination is limited in its range of which combinations could be achieved, recombination within this range is less blind than mutation. The positive results of the more daring mutations which took place in different single organisms using this less risky method are combined. In this sense, I think it would be wrong to neglect that the process of recombination, on the level of the whole evolutionary line, reduces the blindness of evolution (➲also p. 367).

(c) Similarly in respect to *the other class of possible directed adaptive variation*, recombination seems not always to be necessarily blind.[1188] Moreover, the strength at which the two groups of alleles are mixed, i. e. how many crossovers take place, is not random. There is a finite number of crossovers that take place, and there is a specific average number for each species (such 'arm-chair' arguments could be as conclusive as expensive laboratory work). Of course, it would be possible that this specific number of crossovers strongly varies inner-specifically and that its average is constant in all species. This is implausible, because the number of crossovers is a function of many properties of the reproductive system. Actually there are rates for different species as regards how many inter-allelic recombinations take place (recombination rate). Also any two specific gene loci have a recombination rate or recombination frequency indicating how many crossovers will usually take place between them[1189].

Moreover, there is no reason why an inherited specific number of cross-overs should not itself sometimes be the result of adaptations (sometimes it may, certainly, only be the result of drift or constraints etc.). If there is an inherited rate, it appears plausible that this rate is itself an object of adaptation. The recombination rate may either be due to differences in the distribution of genes on their chromosomal basis or to different probabilities of recombination at certain points. Both could be based on adaptation. The simple distance of genetic loci is definitely at least one determining factor in their recombination frequency. A large portion of the genome is constituted by so-called 'introns', which do not become decoded.[1190] The length of an intron, whether evolved for this reason or for a different reason (being an adaptation or an exaptation➲[1096]), may give an advantage to particular adaptive distances. Advantageous

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[1188] I am not concerned with sexual selection here, also leading to an enhanced probability of certain combinations, possibly even of adaptive ones.

[1189] E.g., D. J. Futuyma, *Evolutionsbiologie* (1986/1990), p. 59.

[1190] *Ibid*, pp. 55, 57.

distances causing advantageous phenotypic recombination frequencies will enhance the probability of an evolutionary line to survive. The direct modification of a specific recombination frequency of two loci has even been experimentally shown. Chinnici has shown that the rate of crossovers of two gene loci pairs in *drosophila melanogaster* (as far as I know, without changes to the introns) can become selected.[1191] Another phenomenon which supports an adapted (not blind) aspect of recombination is, for example, that crossovers are suppressed if an inversion took place where crossover would only lead to gametes with almost no probability of surviving[1192].

In the following, I shall mainly focus on particularly controversial question, whether it is plausible to speak of less blind variation in regard to *mutations* as well. Here it will not always be clear which particular level of evolution is involved. In regard to mutations one may make the distinction between the two classes of adaptive variation made above, but it is more suitable to structure the discussion along different lines.

It will, firstly, be shown that the production of new patterns out of repeated genetic and microbiological patterns is more effective than production based on single chance mutations. Such microscopical repetitions will be shown to be found abundantly in surprisingly different parts of the body. Although this may partly refer to constrained evolution, such repetitions have apparently enabled very complex adaptations, which otherwise would not have been possible. A certain blindness remains, however, as it appears not only possible, but even necessary to distinguish between different degrees of blindness and of changed velocity of evolution.

Secondly, I shall discuss reduced blindness based on preferred macroscopic dimensions of change or on the repetition of morphological structures (compared with mere chance structures). The advantage of such preferred macroscopic dimensions of change may either lie in the (external) relevance of a particular dimension of change over a long period of time or in the (internal) advantage of certain macroscopic building blocks, like repeated segments (compared, as in the case of the above repetitions, to chance building blocks).

If these two points can be shown, it would follow that even if one accepts the central dogma of microbiology (in a restricted sense) it is nevertheless still necessary, also in regard of mutations, to distinguish between different degrees of blindness or sight.

(3) *The adaptive role of genetic continuities in evolutionary change.* Some internal continuities of change may be said to be themselves adaptive. Here I discuss mutation rates at specific loci, the general interpretation of any mutation in terms of the genetic code, the overwhelming role of iterations in adaptive sequences and the role of transposable elements. These phenomena, I argue, strongly suggest that evolutionary trials could reasonably be said to be not always totally blind.

(a) *Mutation rates*[1193] of genetic loci may also enhance the fitness of an evolutionary line. For certain point mutations a low rate may cause less harm. A higher rate may be

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[1191] J. P. Chinnici, *Modification of Recombination Frequency in Drosophila* (1971).

[1192] D. J. Futuyma, *Evolutionsbiologie* (1986/1990), p. 71.

[1193] See e.g., R. Fahrig (Ed.), *Mutationsforschung und genetische Toxikologie* (1993).

advantageous if the phenotypic dimension controlled by this gene has played an important changing role in evolution. A relatively high mutation rate – also in the sense of a predetermined break point – may cause larger mutations (transpositions, duplications etc.). The role of resulting repetitions is discussed below (➲ pp. 382 f.).

A precondition for regarding mutations as being adaptive is that mutation rates are inherited and can themselves be modified. Advances in genetics have shown that mutation rates do not simply fall from the sky, but are at least partly caused by the inherited and modifiable structure of the reproductive system. There are also systematic causes which can change the mutation rates of certain types of mutations, like specific chemicals or other genes (mutator genes). Mutator genes, playing a role in regulating replication, may for instance enhance the probability of a certain direction of base pair mutations in the whole organism.[1194] The mutation rate of single loci can also be modified by transposable elements, as elaborated further down (➲ pp. 384 f.).

If there are predispositions to certain mutations, provoked by genes or chemicals, and if there are certain trials, which are systematically more advantageous than others (as I argue below), then it is plausible to assume that those rates become inherited more often. If a species or a certain gene of a species has a particular average number of variants (column one of Figure 13), or an average amount of change (column two), those species will flourish which produce such variations. Then mutations, like other evolutionary processes should (partly) be understood as having an enhanced fitness. Without advocating pan-adaptationism, the process of evolution itself, as I have emphasised in this work, is also object to evolution as well as partly object to adaptation.

(b) *Genetic code.* Before discussing the phenomenon of repetition, I briefly want to treat the general and seemingly trivial phenomenon of the genetic code. Even if the mutation rate in question is not internally advantageous or externally adaptive, the genetic code, I think, already renders any mutation less blind than one would otherwise conceive.

At the lowest level of this code, only the four base pairs, the four letter alphabet of the nucleotides, is used. Theoretically, one may well think of mutations which do not use this code. But actually the code is universal (neglecting some minor differences in the code of mitochondria) and, likewise, mutations are almost always expressed in this code. More deviant changes do seldom take place and are largely excluded by repair mechanisms. One may argue that this inner dynamic is constraining evolution and preventing the evolution of a fundamentally new code. This would also be problematic to universal Darwinism. However, the nucleotide code is widely regarded as having particularly positive properties for information transfer. Hence the exclusion of other trials from the outset can, at least partly, be interpreted in an equally problematic way for Darwinism as for adaptive directedness and the reduction of evolutionary blindness.

The next level of the genetic code organises the four letters into three-letter syllables: triplets. These so-called codons are the blueprints for the basic amino acids. There are $4^3 = 64$ possible triplets. But not all combinatorial variations are used. The calculation already presumes a unified left winding of these amino acids. Moreover,

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[1194] Cf.: D. J. Futuyma, *Evolutionsbiologie* (1986/1990), p. 83.

these 64 variations are actually only interpreted in 20 different ways; the code is redundant. There are only 20 amino acids used as the basic building blocks for the protein synthesis. Hence the space for possible mutations is already drastically reduced – or one may say directed –, since any genetic code for protein synthesis is interpreted in terms of these 20 amino acids.[1195] A mutation which hence only again leads to one of these amino acid – only at another locus –, in any case produces a building block of high usefulness and internal compatibility; this mutation has an enhanced chance of being adaptive or non lethal compared to a hypothetical production of another completely random molecule. In so-called frame shift mutations, where the pattern of how the triplets are decoded is radically shifted, at least still amino acids are produced[1196]. Although mutations that only change the used amino acid may still well be harmful and, on the level of the metabolism, may lead to relatively new molecules, such directed and constrained mutation will generally be more adaptive than a trial based on chance only.

The genetic code itself appears to repeat structures which have generally turned out to be advantageous building blocks (and to some extent may also have constrained evolution). In this sense mutations which are almost all expressed and interpreted in terms of the genetic code can for this reason already be regarded as being somewhat less blind and wasteful than, theoretically, one may conceive.

(c) *Repetitions*. We now come to the role of more complex repetitions in the genetic code and the microbiological structure. The duplication of complex genes is apparently a central aspect of evolution, based on inherited mechanisms and linked to different mutation rates, mutator genes, the organisation of the genome and movable elements (➲ below). The existence of repetitions within and between different complex structures appears to support the view that a 'recycling' of old complex tested structures could more easily lead to complex adaptive structures than a process which builds such structures by blind single steps.

It is argued here that it is false to ignore the common phenomenon of a duplication of genes and the largely identical repetitive sequences as an evolutionary factor; they appear to be indispensable for most complex adaptations.

Especially in eukaryotic 'higher' organisms can many repetitive sequences be found, whereas almost non are found in the genome of viruses and prokaryotes, which where long the main objects of genetic research. Sequences of single copies only still build 90 % of the genome of the lower eukaryotes, like fungi, but only 20 % of the DNA of some plants and amphibia. In higher organisms, generally the repetition of existing complex genes, and not only point mutations, appear to be a highly important phenomenon.[1197]

[1195] The redundancy of the code also leads to the fact that many mutations are 'silent' with no direct effect on the phenotype.

[1196] Cf.: D. J. Futuyma, *Evolutionsbiologie* (1986/1990), p. 75.

[1197] *Ibid*, pp. 57, 74 f., 85, 512 f. When I am quoting Futuyma in this section I mainly refer to the facts provided by his profound textbook. My interpretation seems to me to be suggested by these facts, but Futuyma himself in a more guarded way does not – at least not explicitly – give the interpretation I am promoting here.

A part of these repetitive sequences however, seems to be counter-adaptive at the level of the individual, the group or the species. A class of such repetitive sequences indeed appears best explained in the sense of selfish DNA (➲ below). But, as we shall see, complex repetitions also play a role in almost any complex adaptive structure. The two cases can not always be strictly distinguished. Selfish DNA may, as a side effect, produce an adaptive sort of variation (this mechanism would be an exaptation). This will then be less counter-selected at the level of the organism, group or species and may be regarded as an adaptation on these corresponding levels. In such cases the border between selfish and adaptive repetitions is blurred. There also seems to be different types of repetitive DNA; highly repetitive DNA, for example, is often not transcribed[1198]. I do not promote the idea that all cases of repetitions are adaptive, but think it is enough to show that without repetitions the complex adaptations which have been achieved would not have taken place in the given time. In this sense, I argue that inclinations to a certain kind of repetitions may have made evolution less blind.

Repetition is found in many functionally important sequences of the genome. In the coding sequences (exons), for example, the regulation for a starting point of a transcription is regularly controlled by the same repeated code.[1199] Also many, if not most structural genes, which code the proteins of eukaryotes, are members of *families of gene-complexes*[1200], whose members have a similar structure. Even gene-complexes with many thousands of members are found to be very homogeneous in their nucleotide sequence.[1201] There are, for example, over ten nucleotide sequences which are very similar to the overall sequence of haemoglobin. Moreover, the haemoglobin protein of human adults itself consists of the repetition of *two* α and *two* β polypeptides ($\alpha_2\beta_2$). But besides the repetition of each polypeptide α and β, α and β also strongly resemble each other in their exons and in their groupings of exons. It is actually assumed that the different haemoglobin chains of vertebrates have evolved through gene-duplication from much simpler structures. Also many so-called pseudo genes, which do not become expressed phenotypically, have this structure.[1202] If reactivated, they may have a higher – although still low – probability of being adaptive than a random nucleotide sequence of the same length. It actually appears that both the repetition of large genetic sequences as well as an repetitive internal structure are quite general evolutionary phenomena, which appear to be crucial for many adaptive structures.[1203]

[1198] *Ibid*, p. 57.

[1199] *Ibid*, p. 55.

[1200] I here use the term 'gene complex' to indicate the difference to single genes, as defined by gene-atomists. Gene complexes are longer strands of DNA, which may code a whole long polypeptide (➲ pp. 264 f.).

[1201] D. J. Futuyma, *Evolutionsbiologie* (1986/1990), pp. 57-58, 526 f., 535.

[1202] *Ibid*, pp. 58, 79, 509, 513, 514.

[1203] Cf.: *Ibid*, pp. 530, 537.

> Repetitive and only slightly differing structures, interrupted by long introns, can also lead to what is called ‘exon-shuffling’.[1204] Such a ‘recombination’ of codons presumably leads with a higher probability to a protein which works better than other mutational changes. The long introns may lower the probability of cutting through an exon.

The duplication of existing complex genes appears to be more advantageous for the building of new structures than building them in single chance trials only. Single steps, do of course also play a role in the divergence of these duplicated genes,[1205] but it appears that evolution has shown that the use of formerly tested building blocks in another context can often lead to quicker adaptation than the production of each newly used building block completely from scratch. In this sense building blocks which have turned out to be advantageous may, systematically, have survived better, and hence more often became used in further trials. In this – of course limited sense – such trials are less blind than trials based on untested building blocks.

(d) *Transposable genetic elements* play a role in the production of duplicated repetitive DNA and gene-families. Other causes for repetitive DNA are adaptive points of fracture, mutator genes and the general structure of the reproductive system. Transposable genetic elements appear to be a general characteristic of eukaryotes. [1206]

There are two types of transposable elements, one type of which is replicated only if integrated in the genome (transposons) and another type of which whose replication is not bound to the replication of the nuclear DNA at all (episomes).

Transposons seem to have a characteristic sequence-structure at their endings and in some species build 10 % of their DNA. Some transposons code RNA which by reverse transcription is introduced as a new copy into the DNA. It appears that the fidelity of transposons is regulated by general factors and by specific other genes. There seem to be different probabilities for an insertion at different regions of the chromosome.[1207]

Both types of transposable elements seem to play a role in the reverse transcription of DNA sequences. In the human genome the so-called Alu-group produced by reverse transcription has over 500 000 copies. A relevant part of the mammalian genome seems to be based on reverse transcription. Transposable elements could particularly lead to mutations by inserting regulatory stop and start signals.[1208]

Some transposable elements multiply genes with apparently adaptive phenotypic effects. In bacteria particularly genes for resistance against medicaments and for the metabolism of new substrates are often found in episomes and transposons.

But there are also many transposable elements where the adaptive function is not, at least not directly, apparent, because they mainly carry the information to reduplicate themselves. Here Dawkins’ concept of selfish DNA seems to be appropriate.[1209] Such selfish genes may flood the genome with sequences which are not useful to the organism as a whole.

[1204] *Ibid*, pp. 76 f., 538.

[1205] *Ibid*, p. 537.

[1206] *Ibid*, pp. 57, 78 f., 516 f.

[1207] *Ibid*, pp. 518.

[1208] *Ibid*, pp. 79, 81, 512, 518.

[1209] *Ibid*, p. 519; ➲ footnote 1187.

Nevertheless, here also one has to consider that such a proliferation will sometimes lead to exaptations. The abundantly copied structure may still be more similar to a possibly adaptive structure than to a mere chance base sequence, because the sequence is at least coding something and only relatively small changes may be necessary to change the sequence in order to code something useful. Moreover, such genes may reactivate or deactivate genes and seem to play a role in causing the inversion and deletion of genes. Although most mutations are lethal, an increased overall rate of a certain mutations may also be positive for an evolutionary line. An effect started as selfish DNA can become an adaptation. Alternatively, if the effects of selfish genes are too radically counter-adaptive at the level of the organism (or group or species) they will have a higher probability of either facing counter-selection within an evolutionary line or of dying with the whole line which they had subverted. It is actually known that selection can regulate the number and the sort of transposable elements. For instance, selection may favour transposons or episomes which produce genes that transcribe rRNA, to be found some hundred times in the genome[1210].

The similarities of the above mentioned families of gene complexes become even more remarkable, since these similarities are not even always due to their common origin. The central role of repetitions, independent of this point, is remarkable on its own, since the recycling of used *complex* structures in my view has to be interpreted to be less blind than the totally blind production of single trials. However, members of gene-families which evolved based on duplication long ago, often additionally show the obvious effects of parallel evolution, a phenomenon called '*concerted evolution*'. For example, a certain genetic change which is not observed in apes at all, is found in all 400 copies of a certain human gene family, whose members are also mostly found in apes. Either this parallel mutation arose in all 400 cases incidentally and became fixed – something that is quite implausible –, or one mutation was transferred to other mutations in a more systematic way. Concerted evolution appears to propose that members of a family of gene-complexes do not evolve totally independently from each other.[1211] There are different hypotheses about how this may become explained. Transposable elements may play a role here as well. In any case concerted evolution points to a relatively organised way of changing different sequences of the genome. It appears plausible that there are adaptive mechanisms which secure the compatibility of different processes and codes, i. e. which lead to trials which are in this sense less blind. More research on the phenomenon of concerted evolution is required.

Not only in respect to gene-complexes but also in respect to complete parts of chromosomes, chromosomes as wholes and sets of chromosomes repetition seems to be crucial for evolution.

We have already seen that close species are often only distinguished by re-structured karyotypes created by reciprocal or non-reciprocal translocation of parts of chromosomes (➲ p. 273). Duplication of single chromosomes and also general polyploidy appear to be important evolutionary factors. In plants, for instance, polyploidy is known to be a prevailing form of specification. In such cases the trials, in a way, can

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[1210] *Ibid*, pp. 522 f.

[1211] *Ibid*, pp. 526-535.

be interpreted to be less blind – although such mutations are also often lethal. The mutation can often directly lead to enhanced robustness and organisms of a larger size. But, perhaps more important, such organisms, if they survive, have a pool of identical genes which work, and which then through a few small (blind) modifications can adopt new differentiated complex functions. The evolutionary line again becomes diploid. A process like this is known, for instance, in the fish family *salmonidae*.[1212] A process which would have evolved new complex functions from scratch through many little mutational steps, would have taken much longer. In this sense I think it would also be false to call this recycling of existing complex structures as equally unchangeable, blind and wasteful as an evolution of such structures by single point mutations (although these point mutations certainly here have their role as well).

In conclusion, it appears plausible to assume that in regard to change there seem to be certain internally advantageous continuities. The ubiquitous 'recycling' of complex adaptive structures at least in 'higher' organisms seems to show that repetitions and recombinations of apparently generally useful building blocks produce new complex adaptive structures more easily than single chance steps. If blindness is understood as strictly as possible, it is reasonable, even based only on the present evidence, to assume, that there are degrees of blindness and sight. I think that, based on the current evidence, it is plainly wrong to claim that it is decided that evolution is unchangeably blind. It appears plausible, and is clearly possible on the basis of present genetic knowledge, that mutation rates, building blocks and mechanisms like transferable DNA are themselves at least partly adapted to produce trials which on average have an increased fitness, compared with totally blind trials.

(4) *The adaptive role of macrobiological continuities in evolutionary change.* The role of a macroscopic advantage of preferred dimensions of change or of repetitions is a more specific topic than that of genetic continuities, since macroscopic continuities are somehow based on genetic ones, whether directly or mediated by developmental mechanisms. A continuity, for example, of adaptive building blocks, as we have seen, can sometimes also be advantageous, without an apparent macroscopic continuity, if based on the usefulness of such building blocks in quite different structures. However, here we are concerned with properties which show continuities in a more direct relation to an environment (in the sense of all columns of Figure 13).

One may even think of adaptive directions of change (third column), as being based on a trend in the changing environment. But are there trends in the changing environment? One possibility would be the permanent change in a certain environmental variable, another an arms race in a predator pray relation, where the same evolutionary direction may be permanently advantageous for each species. A further possibility for adaptive trends could be given even if the relevant aspect of the environment is stable and if many steps in only one direction are adaptive for a long time. Such trends do not in any case last forever. Nevertheless, if they last long enough it appears, based on the above microbiological grounds, reasonable to assume

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[1212] *Ibid*, pp. 69 f, also 74, 512, 514-516.

that an adaptively biased production of variation evolves. Although there is, of course, never a complete guarantee for the future, such trials are adapted, as static characteristics are also adaptive only a certain period of time. But if trials are adaptive they are less blind.

In any case, not only evolutionary trends with a certain direction (third column) could give rise to less blind mutations, but also only the evolution of a preferred dimension of change with many different trials in all directions would violate the assumption of strict blindness (first and second column).

If there are externally given preferred dimensions, or even directions, of change there is no reason why corresponding inner tendencies should not become inherited as adaptations, particularly if we think of the mutation genes and mechanisms mentioned above as causing genetic duplication and concerted evolution. If a dimension of change has played a role over long periods of time it appears probable that those organisms in particular have survived which produce more variation on one such adaptive dimension than on another one. It is not difficult to think of *examples* in which such a general view appears to shed light upon empirical facts.

First, physical height or size have often been important dimensions of adaptation in the evolution of many species, independently of whether it is adaptive to be of large or of little size. The view expound here would predict that variation rates (also the mutation rates) regarding this dimension are higher than on the average (at least for organisms which are known to have evolved most of the above microbiological mechanisms).

Secondly, one may predict a high mutation rate, for example, of the colour of fur of those prey species, which conceal themselves from beasts of prey and which have lived in changing environments, favouring different colours. The *muridae* in its different species may be an example for such an animal. In evolutionary time spans presumably the different colours of fur were advantageous for evolutionary lines of this class. Mouse species today are active at different times of the day and in very different surroundings. The fur of the *muridae* is black, grey, brown, reddish brown, or in some species even bright yellowish. It is known that mouse species have a relatively high mutation rate in the colour of their fur.[1213]

Thirdly, there appears to be a phenomenon of *evolutionary integration*, when changes of certain phenotypic properties are (statistically) linked. The biologist R. Riedl has argued that many traits do not appear to vary independently from each other, because then many more non-adaptive mutations would actually occur. There seems to be a regulatory system which leads to the fact that, for example, the length of legs more often vary together than alone.[1214] Although this is proposed within the framework of the evolutionary synthesis, this, I think, to some extent refers to the concept of correlation of parts, which historically was promoted earlier rather by romantic biology (➲ pp. 92 f.). Independent of how such regulation is genetically and developmentally realised, the question is whether it leads to variation which is pre-adapted. If this is given, as it apparently seems, the strict definition of blindness

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[1213] *Ibid*, p. 83 (referring to Dobzhansky, 1970).

[1214] Cf.: *Ibid*, p. 497.

should in my opinion be taken seriously, which would entail that such phenomena are in contradiction to the assumption of complete blindness of variation. Even if, say, the genetic regulation for legs were simply based on one genetic locus, the variation at the phenotypical level would not be a maximally blind. Another possibility how such a mechanism may be realised, is the coupling of genes based on either a close location on the same chromosome or on genetically concerted evolution, which is treated above. In any case, if the occurrence of non-adaptive variations is probabilistically reduced, then it is false to assume an unchangeable blindness of evolution.

Finally, we may think of a typical phenomenon, in which explicit morphological repetition is central – a phenomenon which is also particularly pondered on by romantic biology. Goethe claimed that the parts of plants could be understood as the transformations of one underlying structure, that of an 'ideal leaf'.[1215] I have argued above that genetic repetition should be regarded as an evolutionary factor in its own right, which has often reduced the blindness of variation. Closer scrutiny of developmental logic and self-iterative mathematical structures may show that Goethe was not totally wrong in stressing the role of macroscopic repetition in its own right (although he apparently took his claim too far). Although totally new changes caused by point mutations obviously play a role in evolution, I think research should be much more concerned with the role of repetition as a developmental and evolutionary factor. (Phenotypic repetition is even found in such basic phenomena as the structural units of the body, the cells.)

In regard to macroscopic structures, here I here only mention the one example of body segmentation, which is particularly well exemplified in the taxon of *articulata*, and especially in the *annelids* (worm-like animals) and the *arthropods* (e. g. the millipedes), but can also be found in humans. Could a totally undirected variation really be said to lead to such immense receptions of highly structured modules? Although matters are presumably more complicated, than I suggest here, as a rule of thumb, in species with a high segmentation, all other things left equal, there will be more mutants which vary in regard to the number of segments, than in species with no or few segments.

It is not *a priori* evident that there is really a simple link between genetic and morphological repetition. But actually, the phenomenon of segmentation is known to be linked to the phenomenon of genetic repetition, shown above as itself being possibly adaptive. The correspondence of phenotypic segmentation and repetitive genetic sequences support the hypothesis of the central importance of repetition of whole gene complexes (and only their later specialisation) for macroscopic morphological properties as well.[1216]

A last example, in which the role of a preferred dimension of change may have played a role, is the phylogenetic increase in volume and in the microstructure of the human brain. The acceleration of evolution in this adaptation has often been regarded as a problem for strict Darwinism and might *partially* have been made possible by an increased probability of variation in these dimensions.

[1215] J. W. Goethe, *Die Metamorphose der Pflanzen* (1790).

[1216] D. J. Futuyma, *Evolutionsbiologie* (1986/1990), pp. 491 f.

If there are any systematically preferred adaptive dimensions of change, as actually suggested by empirical evidence and theoretical plausibility, this would violate the assumption of the total blindness of trials. This is independent of the question of how such mechanisms are genetically and developmentally realised. But the repetition of complex morphological structures is sometimes linked to the repetition of complex genetic structures, as was shown in the last section, and is often based on mechanisms which themselves appear to be inherited and the object of adaptation. The production of complex morphological structures out of adapted building blocks, appears to be easier than simple production out of chance elements. Although naturally a degree of blindness always remains to be given, certain dimensions of variation which have turned out to be particularly adaptive may have accelerated evolution and reduced its blindness. The more radical claim, that there are not only adaptive dimensions, but also adaptive directions, can not be supported explicitly here. This represents an open question, which may soon become resolved by evidence from the growing field of genetics. In respect of adaptive dimensions of change I hope to have provided some evidence which supports the view of a less radically blind evolution. Also here genetics should, in principle, soon provide us with more rigid investigations. Based on present evidence, however, I think, it appears reasonable to assume that there are preferred dimensions of biological variation which are partly adaptations and hence less blind. Given this, it is plainly false to assume that evolutionary variation has, systematically, never a "bias towards bodily improvement"[1217].

(iv) Adaptive Variation as Reaction to the Environment?

It might even be possible to go one step further: some aspects of variation may be regarded as an active reaction of the biological entity to certain environmental conditions. In this sub-section I focus mainly on the level of organismic variation.

If there are adaptive dimensions of change or adaptive mutation rates, then there is, in principle, no reason why there should not also be cases of environmentally triggered adaptive types of variation. Although this presupposes a slightly more complicated mechanism, one does not need to assume direct instruction by the environment, but simply a process of triggering a dimension of variation or certain mutation rate which has become adapted. More research has to be done on the correlation of mutation rates, about which we know increasingly more, with certain environmental situations. Here only a few possible examples, mostly of unspecified reactions of variation rates to environmental situations, will be discussed. We consider, whether apparent systematic changes in organismic variation in response to environmental change, might be interpreted as a systematically advantageous strategy for an evolutionary line that is used to better get out of an adaptive valley.

(1) It is commonly acknowledged that, when "stressed, most organisms quickly stop reproducing, conserving energy and waiting for better times."[1218] This is a quite common phenomenon which is also found in humans (lecturers, for example, may be acquainted with passion killers such as stress).

[1217] R. Dawkins, *The Blind Watchmaker* (1986/1991), p. 307. ➲ footnote 1174.

[1218] This is commonly acknowledged. N. Eldredge, *Reinventing Darwin* (1995), p. 187.

Such influences on the reproductive activity do not directly influence the percentage of mutants in a population. Nevertheless, an adaptively reduced number of offspring may still be regarded as a less blind way of producing variation. Here only indirectly is the number of variants (column one in Figure 13) affected, not the breadth of the variation. At least in respect to the abundance of trials (offspring) it is worth noting that this is not totally blind.

> I have to concede that this example does not strictly fulfil the criterion which I defined as evolutionary variation at the outset of this treatment of evolutionary blindness. Nevertheless this phenomenon appears to suit in my interpretation of evolution as a process with changing blindness; therefore I mention it here. The following two examples b and c more strictly fulfil the outlined understanding of evolutionary variation.

Another passion killer for human beings is, for instance, depression. In this example the influence of cultural values on the reproductive system is apparent. Missing contentment could also influence activities necessary to sustain one's own survival, like eating and concentration etc.

Even something like what Freud called '*Thanatos*' may play a role here. This assumes that the self destructive tendencies of an individual, which are at odds with the values of his or her group, have an advantage at the group level. I am aware that this might have some similarities to Wynne-Edwards' conception of group selection, a theory which is still widely in disrepute. Nevertheless, we have seen that the gene-Darwinian denial of any properties which are good for the group went too far. It has also been shown that there are different more refined models in which traits advantageous to groups do not have to be undermined by subversion from within (not even always requiring permanent group selection, ➲ 284 f.). Hence in the light of such models, also some phenomena discussed by Wynne-Edwards may become rehabilitated, and shown to, in fact, be referring to the good of the group.

Mechanisms that cause self-destruction or reduced reproductive activity may possibly not be adaptive at all, but the mere side effects of the exhaustion of an organism. But actually most opponents of group selection also interpret this partly as adaptation but now on the individual or gene level. I also think that, independently of the question of the evolutionary level, this behaviour, at least in part, seems to be an adaptation. In this case, the number of variants produced (column one) seems to be changed as an adapted reaction to the environment. This is normally acknowledged, but not taken to point to a fundamental aspect of evolution. I think one should stress it as an aspect of the general possibility of reduction of evolutionary blindness that offspring, in higher organisms, are not blindly born into an unknown future, but with respect to their probable chances of survival. In this limited sense of affecting the number of offspring, variation is not totally blind, but is itself tuned in an adapted way (➲ but see small print above)

(2) It is known that the rate of incidence of cancer is higher when the immune system is running at a low level. From psycho-immunology we know that problems of the immune system are often caused by general frustration or stress in the organism. The normal interpretation of this phenomenon is that full functioning of the immune system simply cannot be kept up if the organism is stressed.

An alternative explanation would – somewhat cynically – consider the possible adaptedness of the mutations themselves, at least for the evolutionary line as a whole.It may be plausible that an increased mutation rate in those evolutionary lines where organisms are stressed is advantageous. It could be assumed that the generally increased probability of mutations occurring also enhances the probability of mutations in the germ line. If organisms, which are stressed over long periods, develop an especially high number of mutant offspring, this would ensure that organisms or populations in a disadvantageous situation have an increased probability of finding a way out of a maladaptive valley.

(3) Actually, under stress genetic transposition elements seem to be released more frequently leading to a higher probability of genomic change. Their copying of other genes seems not to be based on mere chance, but is regulated by a set of rules, probabilistically prefering often used streches of the genome.[1219]

(4) Sexual selection, in a way also produces variation that may be adaptively directed. This directedness may even react to very particular changes in the environment. At least in human beings it is plausible to assume that in the complex cognitive processes of human partner choice, aspects may be involved which react to the needs given in a changed environment. Human partner choice also seems to be linked generally to changing cultural values. These values may, apart from a certain autonomy of culture, also partly lead to a flexible adaptive response to a changed environment – as well as in respect of biological reproduction (➲ on the concept of auto-selection, pp. 394 f., 409 f.).

> In respect to the above examples I have to concede that they are partly in danger of being just-so stories and may actually rather refer to side-effects than to adaptations. Although I think it is reasonable to apply the idea of adaptation to the evolutionary process itself, which has been strangely separated by Darwinians, I do not want to commit the criticised fallacies of promoting an unqualified pan-adaptationism. Moreover, although the examples appear to me to make sense, only a more concrete empirical foundation for such claims render these views secure. Here only a certain plausibility of such views should be pointed out. Furthermore, I have not argued in favour of a even more radical position, claiming the direct chemical control of particular directions of mutations. Although also such a position may in principle have some plausibility, particular of one thinks of the known phenomena of reverse transcription, mutator genes and chemical catalysts of mutations, it may well be given that such a more complex mechanism has never evolved. Actually, Ted Steele, as mentioned earlier, has defended such a more radical view. In any case, such a more extreme position, as we have seen, is not necessarily required for a concept of adaptive variation as a reaction to the environment.

These more daring concepts have not been so clearly supported as, for example, the concept of simple adaptive dimensions of change, discussed in the last section. But based on a multi-level account and a strict understanding of blindness, it at least appears not implausible, that, following my general interpretation, there is also adaptive variation in a particular response to the environment (without assuming a violation of the Weismann doctrine). In this sense variation may even directly react to the changing ‘needs’ of an evolutionary line.

[1219] J. Bauer, *Das kooperative Gen: Abschied vom Darwinismus* (2008), p. 187.

(v) Summary and Conclusion

It has been shown that it is reasonable to regard biological variation rates (e. g. mutation rate, recombination rate, and speciation rate) as not being totally blind in every case, but in being partly themselves adaptations. Such a view gains plausibility if one takes into consideration that these rates can be shown to be somehow inherited. Even at the level of mutation rates there are certain chemicals, genes and extra-chromosomal episomes which appear to catalyse mutations in a systematic way. It seems reasonable to regard some aspects of variation itself as meta-adaptations. In such cases adaptations are not a given state of an organism, but an enhanced probability to mutate along a certain evolutionary dimension.

First, we were concerned with the possibility of claiming the blindness of trials in a tautological way. If change in an evolutionary line is defined as being that which is not known in advance, then by definition every trial is blind. Aiming at a strict definition of Darwinism I have had to abandon this tautological definition, which would otherwise build an impregnable bastion of Darwinism, build on merely terminological grounds. I rather regard the blindness of evolutionary lines as a topic for empirical research. Although trials are concerned with change, there may be continuities in that change, which may be used for mere adaptive strategies. If in particular those lines survive which produce trials which are more adaptive, then the evolved direction of trials could itself be regarded as being adapted, i. e. not blind. It is hence inappropriate to argue tautologically that all change is blind. Likewise in regard to change there may be continuities, so that the old may help to explore the new. In the subsequent sections, I argued that there actually are, for instance, adaptive dimensions of change, adaptive mutation rates and an adaptive linkage of genes.

Secondly, I distinguished between different levels, in which evolutionary variation, in a multi-level account of evolution, is appropriately regarded as taking place. Different descriptive aspects of variation have also been disentangled.

Thirdly, in a longer treatment, I gave support to the view that variation is not always and not on all explanatory levels equally blind. I have distinguished between two types of adaptive variation. There is a flexible type of adaptive variation, which in a multi-level account of evolution is based on pre-selection at another level. Although the composing processes are blind, the relevant fact is that the trials at the level of the whole are not equally blind. The other type of adapted variation requires an enduring importance of a certain dimension of change over a long period of time. I have clarified these two types of adaptive variation for the level of species and for genetic recombination.

The most problematic topic is the possible directedness of mutations. Here I did not structure the discussion along the lines of the above distinction, but firstly treated genetic and microscopic continuities and secondly macroscopic, mainly morphological, continuities.

In respect to the genetic level I have discussed the genetic basis of mutation rates, the role of episomes, concerted evolution and repetition. I can here only mention some aspects of this discussion. Mutation rates are shown to be inherited and also genetically changed. They appear to be the basis for adaptive dimensions of change.

Another important point is that the genome of higher organisms shows an enormous number of repetitive sequences – also in most coded adaptive structures. This suggests the interpretation that the repetition of previously tested complex genetic structures builds the basis of most complex adaptations. Genetic repetitions do not necessarily imply macroscopic repetitions, instead they could also contribute similar building blocks to quite different macroscopic structures. These building blocks seem to have turned out to have a generally higher probability of producing advantageous mutations than plain chance mutations. Without denying the role of blind point mutations, it appears that without the duplication of complex sequences, evolution would not have been able to design complex structures in the time given. There seem to be particular mechanisms that enhance the probability of the duplication of whole gene-complexes. Transposable elements also seem to figure in causing these phenomena. The apparent repetitive use of adapted building blocks, and other phenomena which have been discussed, clearly speak in favour of the concept of directed variation.[1220] Despite the constraining aspect of resulting directions, the strong amount of repetition in complex structures seems at least partly to point also to an adaptive directedness, for example, of a repeated use of such advantageous building blocks.

More briefly, I discussed possible macroscopical and morphological continuities. There may be preferred dimensions of change or even certain directions of change. It appears plausible to assume that some dimensions of change over long periods of time were important for evolutionary lines. If many steps are needed for a certain adaptation or if there is a permanent external trend, then even a certain adaptive *directedness* of mutations is thinkable (I have, however, focused on the less daring claim of adapted *dimensions*). Likewise morphologically, repetition, I argue, appears to play an adaptive role. Of course not any repetition is adaptive, but repetition in average may be more adaptive than complete randomness (although this on the other hand may lead to constraints). Another class of macroscopic adaptively directed variation that I mentioned appears to be an adaptive coupledness of genes, which can systematically decrease the blindness of trials.

Finally, I have argued that these adaptive aspects of variation may even be regulated more particularly in direct response to a situation in the evolutionary line.

In conclusion, without favouring any strictly Lamarckian kind of evolutionary mechanism in biology, variation does not necessarily seem to be equally blind in its strictest sense. This position is at odd with Darwinian metaphysics, if we do not allow a tautological notion of Darwinism. Variation even on the level of mutations appears itself to be adapted, but be it only in the sense of a preferred dimension of mutations. If this is given, the strictly interpreted assumption of a Darwinian blindness of evolution is violated. Likewise, if variation is not totally blind, but could to a certain

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[1220] It is an old idea of critics of Darwinism that trials are more directed, either in an adaptive or in a more constrained sense. E.g., Ch. v. Guttenberg, *Biologie als Weltanschauung* (1967), p. 43.

extent itself be adapted, the other extreme, proposed earlier by the mutationists[1221], that mutations are very well informed and almost omniscient, is also false.[1222] The variation step of evolution seems to be neither strictly Darwinian nor strictly mutationistic. It is neither totally blind, nor omniscient, but located somewhere in between on the dimension I have outlined above (➲ pp. 359 f.). A precise value in how far variation is adaptive can not generally be given. The adaptedness, for example, of mutation rates depend on the specific evolutionary line and the specific locus under discussion. Moreover, blindness has always its share.

A Darwinian might object that he or she regards this position as still being predominantly Darwinian. I indeed have not criticised universal adaptationism in this section, but have done earlier on (➲ pp. 339 f.). I have shown here that it is wrong to regard the process of variation as being unchangeably blind, and to artificially exclude it from becoming adapted itself. Variations, for example, in respect to preferred dimensions, could also be adapted. In this sense Darwinism, if thoroughly applied, undermines its own basis. Measured against the vast number of variants that are theoretically possible (a more than astronomical number[1223]), many actual mutations, according to my strict interpretation, appear to be less blind and rather directed. The degree of their sight differs, as the wastefulness of evolution appears to differ as well. The dogma of an unchangeable blindness, if based on a differentiated understanding of blindness and sight, can in my opinion not be sustained. Hence it appears that a Darwinian process in regard of the criterion of blindness has been transcended by evolution. Evolution evolves and in this respect too has not remained unchanged from the amoebae to Einstein.

c) From Hetero-Selection to Auto-Selection – Discussion of the Third Criterion

The last criterion for our strict definition of a Darwinian process (➲ p. 358) is concerned with the second step in the process. This could either, be positively called 'selection in the narrow sense' or, negatively, 'elimination'. In our definition we have mentioned two aspects of how this step should be specified: selection is (1.) external and (2.) an opportunistic response to the moment. Subsequently, I summarise the justification for why an externality in the second step of a Darwinian process should be assumed. Following this, I discuss the aspect of the opportunistic response to the moment. Finally, I come back to criticise the concept of externality and introduce the concept of auto-selection.

[1221] The term is alluding to a school of biologists at the turn from the 19th to the 20th century, who saw (directed) mutation (mutation pressure) as the main driving force of evolution, opposed to natural selection. Proponents were H. de Vries (who still accepted natural selection), W. Bateson and T. H. Morgan.

[1222] See: R. Dawkins, *The Blind Watchmaker* (1986/1991), p. 308.

[1223] D. Dennett (referring back to Dawkins, Quine and J. L. Borges) has nicely illustrated the hugeness of such a number in his section on the 'Library of Mendel', *Blind Variation and Selective Retention in Creative Thought as in Other Knowledge Processes* (1960/1987), pp. 107 f. (The number is even much bigger since Dennett does not consider the code argument, given above, ➲ pp. 381 f.).

(i) Darwinian Externalism

The characterisation of Darwinism as externalism has been justified earlier in this work and was part of my strict definition of Darwinism. I had the intention of formulating a strict definition in order to reveal an evolution of evolutionary mechanisms which is possibly concealed by often imprecise usage of the term 'Darwinism'. The afore mentioned characterisation has arisen naturally from my historical treatment of Darwinism, out of the need to contrast Darwinism with alternative approaches and out of the discussion of a mere tautological understanding of pan-adaptationism.

Historically, Darwin took over the passive Newtonian understanding of matter (➲ pp. 168 f.). Like matter on which an external force impinges, organisms, according to Darwin, are "not *actively* adapting, but are adapted by the *external* force of natural selection". Organisms, like planets, have an inertial tendency, and – without any force acting on them – they would tend to reproduce similar organisms. Their transformation is only brought into existence by the force of natural selection, which (like gravity) acts externally upon them.[1224]

For example, Lewontin has argued that for "Darwin, the external world, the environment, acting on the organism was the cause of the form of organisms", whereas organisms themselves are the "passive objects moulded by the external force of natural selection".[1225]

Darwin devised his theory to explain organismic adaptations to changes in the environment in natural ways. Darwin inherited this interest in adaptation from Paley. Although Darwinism, of course, can today, not simply be equated with Darwin's theory (➲ pp. 102 f., 106 f.), this assumption is still part of the core of this paradigm. The concept of an exogenous force moulding evolution is also found in process-Darwinism and not only in respect to biological processes, but also in respect to other levels as well; this has also been a main object of criticism.[1226] However, Darwinism has always understood evolution mainly as an adaptation of the body to an environment, or, more generally, an adaptation of the internal to the external.

Thereby Darwinism contrasts itself with other evolutionary theories, which have rather emphasised internal direction and internal constraints. Generally Darwinism, in arguing that evolution is "brought about solely in response to local environmental pressures"[1227], is opposed to approaches which promote an inherent tendency towards perfection, a *Bildungstrieb* or an internal autonomy of processes.

One may object that not only did Darwin formulate the theory of natural selection, but that of *sexual selection* as well. Sexual selection, however, can, likewise, be regarded as stressing an active aspect of the evolutionary line itself.

But Darwin in his middle period, his most 'Darwinian' period, focused predominantly on natural selection. The title of the *Origin* is significantly 'The Origin of Species *by Means of*

[1224] D. J. Depew, B. Weber, *Darwinism Evolving* (1995), pp. 9, 89.

[1225] R. C. Lewontin, *Gene, Organism, Environment* (1983), pp. 273, 275. ➲ Also footnote 1149.

[1226] For example, in respect to economics: E. L. Khalil, *Neo-Classical Economics and Neo-Darwinism* (1992), pp. 35-36. G. Soros, *Die kapitalistische Bedrohung* (1997), p. 26.

[1227] P. Bowler, *Darwin* (1990), pp. 155, also 156, 161.

> *Natural Selection*' and even in other editions of this main work there are only few paragraphs on sexual selection. Hence, why should sexual selection be regarded as being more at the core of Darwin's theory than the evolution of acquired characters, which he also mentions in about the same length?
>
> Moreover, Darwin in his middle period only believed in the existence of single organisms. But if there were no larger units of explanation, then sexual selection is also exogenous simply in respect to each organism. Only in a multi-level account, which I have also supported in this work, may sexual selection be said to transcend Darwinian externalism.
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> Proponents of the evolutionary synthesis in its second phase, as we have seen, have partly accepted higher explanatory levels, but as also mentioned, sexual selection was also met with disapproval by important advocates of the synthesis.[1228]
>
> Gene-atomists again have rehabilitated sexual selection, but have not regarded it as an emergent new mechanism but, rather, a phenomenon reducible to (external) gene-selection (➲ pp. 142 f.).

I think Rensch summed up the spirit of Darwinism excellently: "All known evolutionary rules can be explained by mutation and selection. The assumption of autonomous creative principles or driving forces is inappropriate. Only alterations to environmental factors are decisive for the formation of new species and higher categories."[1229]

Furthermore, if selection were to be defined differently as being external *or* internal, then the claim would lose any meaning. If, for example, internal tendencies and needs determining the course of evolution were called Darwinian, then simply everything would be called a selection process and the second step of a Darwinian process would itself become a completely vacuous claim. In the earlier section on pan-adaptationism I elaborated in detail upon the fallacy of making Darwinian claims in a tautological way, something which also redefines internal tendencies as being adaptations. If any internal direction giving force is called adaptive then simply any process can be called adaptive, since the survival of the survivor is a true but an empty tautology (➲ pp. 339 f.). Similarly, as discussed in the section on tautological aspects of pan-selectionism, the second step in a Darwinian process becomes vacuous (and also does not necessarily lead to adaptation in any meaningful sense) if simply any cause of survival is meant. I do not dispute that there are causes in general for an entity 'to be or not to be' (➲ pp. 350 f., particularly pp. 356 f.).

We come back to a critical evaluation of Darwinian externalism, after the concept of momentaneous opportunism, the other defining aspect in the selective step of a Darwinian process, has briefly been expounded and discussed.

(ii) Opportunistic Response to the Moment?

As I am aiming at a strict definition of a Darwinian process in order to achieve the conceptual resolution necessary to distinguish different evolutionary processes, another criterion for the discussed selection step of a Darwinian process becomes

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[1228] S. J. Frankel, *The Eclipse of Sexual Selection Theory* (1994), ➲ also p. 133.

[1229] B. Rensch, *Historical Development of the Present Synthetic Neo-Darwinism in Germany* (1980), p. 298; here quoting an article of himself from 1943, p. 52.

evident. In Darwinism, the term ‘selection’ – despite its almost theological connotations – points to a process of differential survival, which is, as Mayr states, a totally “opportunistic response to the moment”[1230]. If we were not to demand this criterion for Darwinian selection, then it would also be possible to call any forward-looking, foresighted selection process, even a provident external selection undertaken by God, Darwinian. Darwinians have always stressed that the present and local environment alone is relevant to selection. Hence, it is appropriate, to require of a proper Darwinian process that its second selection step be such an opportunistic response to the moment and that it be taken without any foresight. (This is somewhat similar to the concept of the blindness of *variation* which I dealt with earlier ➲ pp. 368 f.).

This criterion is normally accepted and is even fundamental to the ideological message which Darwinism conveys. But if taken seriously and applied without double standards, I think, it becomes apparent, that not all selection processes actually fulfil this criterion. This, however, would be in contradiction to the claim of a general validity of universal Darwinism (➲ pp. 205 f., 333 f., 350 f.). This can only be sketched here.

For example, artificial selection by human breeders is not necessarily Darwinian in this strict sense. Breeders may, for example, select cattle for breeding because they are resistant to a certain virus, which has not yet become epidemic. Selection, of course, happens at the very moment it happens, but in this example the selector uses his or her knowledge in order to anticipate selection pressures which might occur in the future.

A similar line of argument appears to be applicable to biological ‘selectors’ (even to what in the next section should be called their ‘auto-selection’). Here I give an example concerning involuntary abortions which seem to occur during the human gestation period. From 100 fertilised egg cells only about one fifth survives until birth. About 70 % of these abortions are involuntary, while 30 % are deliberate.[1231] Of course, perhaps, all involuntary abortions might simply be regarded as accidents. But partly, at least, they appear to be explainable as adaptations. In the long run, those organisms or species, which in the case of a developmental monstrosity or of a breakdown of large parts of the embryo’s metabolism, develop a mechanism of an *early* natural abortion will save resources and have advantages in survival. Actually 55 % of aborted embryos die very early and are even unrecognised by their mothers in the first weeks of pregnancy. In terms of evolution it would be plausible – particularly if starting from a Darwinian viewpoint – that, if there is apparently no chance for survival in the long run, involuntarily abortions may take place as adaptations (and, perhaps, also constrain evolution). How fine such a process could be and how well tuned it is is disputable, but there is in principle no reason why the existence of such a

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[1230] E. Mayr, *One Long Argument* (1991), p. 44; *Evolution und die Vielfalt des Lebens* (1978/1979), p. 204.

[1231] These statistical numbers relate to Germany, but they, I think, should, in principle, roughly be similar for other countries as well. H. Rauh, *Frühe Kindheit.* p. 137. In: R. Oerter, L. Montada, *Entwicklungspsychologie* (1987). Particularly the number of deliberate abortions will vary, but also the number of involuntary abortions may well differ due to differences in health systems, environmental factors and their genetic basis.

mechanism should be denied. Given the existence of *some* mechanism like this, selection can no longer be seen as totally an ‘opportunistic response to the moment’➲[1230]. According to our definition it is, hence, not strictly and purely Darwinian. Based on an adaptive process of its own, an internal selection process may on the whole render evolution a little less wasteful and even somehow more directed.[1232] This can be regarded as another type of example for the tendency of Darwinism to undermine and transcend itself.

(iii) Auto-Selection and Autonomy

In the last but one section (➲ p. 395) the externality of selection has once more been justified as being a defining criterion of the second, selectional, step in a Darwinian process. This has been based on historical as well as on systematic considerations. In the present section, it is shown that the criterion is not always fulfilled by existing evolutionary processes. In respect to it the universality of Darwinism, as sometimes assumed, is also shown to be wrong. It is also in this regard that the evolutionary processes themselves appear to evolve. Given a concession to an evolutionary multi-level account, which I elaborated upon previously (➲ pp. 245 f.), the necessity in acknowledging – in an of course limited way – that the evolutionary mechanism itself even changes in the biological stratum will be shown. In this sense evolutionary processes that have evolved themselves are not always Darwinian in the strictest sense of the word.

The criterion for the externality of selection adequately contrasts Darwinism with certain classes of *alternative schools of thought* (➲ pp. 359 f.), which have actually often criticised this aspect. As mentioned, Darwinism was historically opposed to earlier evolutionary theories, which stressed the role of internal form. This concept was cardinal both to early essentialist conceptions in biology, which denied evolution (➲ pp. 92), and to romantic biology (➲ pp. 95), that stressed an inner evolutionary unfolding of form.

Later on, these research traditions partly continued to exist as relatively unimportant heterodox schools of thought. Likewise, the evolutionary synthesis had and has difficulties in integrating in particular the disciplines of morphology, developmental

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[1232] There are many other empirical facts which may be interpreted in this way. We may, for example, think of a combination of group selection and, what I called, systemic individual selection, in which a once installed system which may internally stabilise a property whose loss could result in the extinction of the whole group. Systemic individual selection was discussed in a detailed way, earlier on (➲ pp. 284 f.). Even the gene-atomist view, with its metaphors of almost conscious genes, not only proves to be a most radical form of Darwinism, but also once more to undermine its own approach. It has become commonplace to emphasise the investment of genes (e. g. of parents) into their future. E.g., R. Dawkins, *Parental Investment, Mate Desertion and a Fallacy* (1976), p. 132. In my opinion these phenomena should rather be interpreted in the sense developed here and in the subsequent section. The active internal process of autoselection may replace the passive Darwinian concept of heteroselection, and may include a foresightful pre-selection which is itself an adaptation.

biology and palaeontology into a common, mainly Darwinian, framework.[1233] In these disciplines these heterodox schools still have a certain hold, which is presumably partly due to the disciplines' demand that a focus be placed on the internal logic of forms.

However, in contrast to the radicalisation of Darwinism, the role of internal constraints and internal direction have recently once more became a topic of increased interest (➲ pp. 144 f., 343 f.). Critics of ultra-Darwinism have partly even favoured a full paradigm shift to a more morphological or developmental biology, as, for instance, advocated by the biologist Goodwin. Likewise the school of so-called *critical evolutionary biology* (Senkenberg Museum), for example, focuses on the internal process of reconstructing body plans by determining invariant necessities.[1234] Theories of *self*-organisation (*autopoiesis*) too, which are based on system theory and the complexity revolution, stress the complex *internally* governed organisation of change. But many critics of pure Darwinism do not favour a full paradigm shift, but, for instance, like Gould, only stress the incompleteness of current Darwinian evolutionary theory. The critical stance towards strict Darwinian externalism and the support of a more active role for the internal in an evolutionary process of construction, is not necessarily restricted to the above mentioned disciplines, but may today, for instance, also be found in microbiology (➲ pp. 147 f., cf. also pp. 380 f.). Moreover, there are phenomena at the core of Darwinian evolutionary biology, which reveal the necessity of accepting the relevance of internal dynamics in evolution (➲ pp. 291 f., 409 f. and below).

> Even authors who clearly regard themselves as Darwinians sometimes seem to accept such internal tendencies which are here treated as the hallmarks of theories opposed to Darwinism. For instance, the (perhaps rather existentialistic) Darwinist Monod stresses that to a certain extent the organism itself chooses its selection pressure.[1235]
>
> Even phenomena pivotal to sociobiology, which are often interpreted as evidence for militant gene-Darwinism, could in this respect be interpreted as undermining Darwinism. The concept of investment, crucial to the theories of kin selection and reciprocal altruism, presumes a self-selection on the level of related or co-operating organisms, which takes probabilities of future happenings into account (➲ also footnote 1232 and pp. 371 f.).

Before discussing particular cases myself, I discuss this phenomenon of internal selection in general and introduce a clearer terminology.

As concluded above, Darwinism in its strict sense requires the selection step in a Darwinian process to be external. In order to make this requirement more transparent and explicit here I use the term 'hetero-selection'. This term is in a way a pleonasm, since selection in any case appears to refer to an external selector. Moreover, it has been shown, that alternatively if one were to understand selection as *any* cause relevant for the survival of a certain evolutionary line, then selection in an empty tautological sense would always be given, since it is an apparent truth and not a particularly Darwinian assumption to suggest that there are, of course, always reasons why

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[1233] Cf.: E. Mayr, W. Provine, *The Evolutionary Synthesis* (1980).

[1234] This school seeks invariants not in pure morphology, but rather in bio-mechanical terms. Cf., M. Weingarten, *Organismen – Objekte oder Subjekte der Evolution?* (1993), p. 280, ➲ footnote 644.

[1235] J. Monod, *Le hasard et la nécessité* (1970/1991), pp. 27, 115-116.

survivors survive (➲ pp. 356 f.). Such a largely empty claim would entail that selection became understood in such a broad sense that it is not required to lead to adaptation to an external environment at all, since internal trends would also be redefined as processes of selection (➲ also pp. 339). Nevertheless, selection is actually sometimes used in such a tautological way. This is the reason why I explicitly use the term 'hetero-selection' here.

To refer to internal, rather non-Darwinian, causes of survival which do not necessarily lead to adaptation, I use the corresponding opposite term 'auto-selection'.[1236] If one uses 'selection' in its restricted and proper sense, it is a *contradictio in adiecto*. But since 'hetero-selection' is used here in this proper meaning, the term 'selection' is set free to mean in fact merely any cause of survival. 'Auto-selection' should in this sense refer to any *internal* – not necessarily externally adaptive – cause of preferred survival of an evolutionary line. In auto-selective processes the entity in question is itself, in a rather non-Darwinian way, a main cause of the direction of its own evolution. The term 'selection' within 'auto-selection', if restricted to the second step in a Darwinian process, is also still conceptually linked to the Darwinian aspect of the variation of evolutionary lines. The concept of variation, however, has been dealt with previously (➲ pp. 364 f., 368 f.).

But why introduce the term 'hetero-selection' at all, if one can use Darwin's original term 'natural selection' instead? The notion hetero-selection, as introduced here, is not, at least not directly, synonymous with natural selection. Hetero-selection is a more general notion since it can be directly applied to very different ontological levels, not only to biological ones, but also to other levels accepted at least by process-Darwinism. To take an example from the history of ideas, historically, 'Darwin's dangerous idea' had a difficult start. Presumably this was partly due to the external counter-selection represented by certain theological convictions of that time. (The clash between Huxley and Bishop Wilberforce has become the icon of the conflict between Darwinism and theology[➲356].) It is inappropriate to call such a process '*natural* selection', since the selecting force in this example is not meant in any direct sense to be nature, but rather other ideas. Since the selector may still be exogenous one can still speak of hetero-selection.

None the less, hetero-selection and natural selection are closely linked and not only in the sense that natural selection is a specific type of hetero-selection. If one assumes that only processes of hetero-selection are involved at different levels, it appears plausible that hetero-selection – indirectly and possibly with a time lag – is ultimately only a mediation of natural selection. In opposition to this, the approach I favour in this work, can be seen as regarding hetero-selection as not always referring ultimately to natural selection, since, for example, on the level of culture many relatively autonomous processes of auto-selection take place, so that cultural hetero-selection may not necessarily only mediate natural selection but also autonomous tendencies of culture. However, process-Darwinism, which does not accept auto-selection in general, has, I think, to claim that hetero-selection ultimately refers to

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[1236] On possible ways to disentangling internal and external causes even in respect of morphology, ➲ p. 343.

natural selection. In this view there is no true autonomy; biological external nature remains the only ultimate selector. As we have seen, in this understanding, cultural entities, like words, concepts or theories, finally only serve the biological survival of the entity in question. Hetero-selection and natural selection finally coincide, and in this respect process-Darwinism becomes identical to biologistic Darwinism. Indeed, it only differs from it in assuming the existence of mediation processes. In such a view it is in fact justified to conclude that "no species, ours included, possesses a purpose beyond the imperatives created by its genetic history"[1237].

Now particular mechanisms are considered which may be interpreted as auto-selection, without, of course, thereby intending to deny or to neglect processes of hetero-selection. In respect to the cultural stratum, only cases should be mentioned in which auto-selection seem to be involved. Then I turn to examples of biological auto-selection, which have partly been discussed at depth in this work before. Biological processes are scrutinised more closely, since their existence appears to be more controversial.

To a great extent human beings appear to be 'selected' by the cultural world they themselves have created. Human survival is in general not only determined by the changing climate (even this is influenced by humans), but also, for instance, by a system of values, morals and laws. These created values also appear to have a certain, I think partly positive, autonomy. They somehow 'reproduce' themselves without referring to an advantage in biological nature. These norms, for example, to some extent help the weak and vulnerable, and sometimes also those who help them (but cf. also ➲ pp. 51 f.).

Similarly theories, even if we regard them as a problem, may to a certain extent select themselves. This becomes apparent, for example, when we look at Lakatos' concept of theoretic protective belts (something that we have come across repeatedly in this work).

In respect to economic processes, previously I pointed to some structural similarities among the thinking of certain economic schools of though and Darwinism. E. L. Khalil, who has pointed to many similarities between neo-Darwinian biology and neo-classical economics, particularly criticises the concept of an externally given selector likewise found in neo-classical economics.[1238]

> According to Khalil, neo-classical economics idealises consumer preferences as an ultimate selector. Consumer satisfaction was wrongly assumed to be the externally given gauge of economic efficiency. Actually, however, consumers do not have perfect knowledge and may even have, for instance, a certain 'irrational' loyalty to firms. Additionally, firms are not simply externally selected in regard to how far they satisfy consumers' needs and interests, but may themselves have the power to shape the preferences of consumers and even possibly to manipulate their knowledge.[1239]

[1237] E. O. Wilson, *On Human Nature* (1978/1995), p. 2. Cf., more recently, Th. Junker, S. Paul. *Der Darwin Code* (2010), pp. 189 f.

[1238] This has generally been criticised, for example, by Boulding and Th. Veblen. H. Driefenbacher, U. Ratsch, *Verelendung durch Naturzerstörung* (1992), p. 241.

[1239] E. L. Khalil, *Neo-Classical Economics and Neo-Darwinism* (1992), pp. 35, 50-52.

Equally evolutionary biology has, in my view, to acknowledge that selection (here broadly meant as the causes of survival) are not always external in a Darwinian way. (Cf. generally, ➲ pp. 342 f., p. 356) Alternative internal auto-selective processes can generally lead to two results.

First, auto-selection may reduce blindness in the evolution of an evolutionary line and in a way may even accelerate the adaptive process. This resembles the possible reduction of blindness of variation, as elaborated above (➲ pp. 377 f.). Likewise, auto-selection may itself be adapted to accelerate the adaptive process and may eliminate the variation of organisms with particularly small prospects very early on. Some microbiological examples have been discussed which can, presumably, be subsumed under this interpretation. An example of this is provided by the genetic repair mechanisms that prevent mutations not expressed in the established genetic code from taking place (➲ p. 381). Here mutations using different molecules to the usual ones in the genetic code are eliminated in advance. Thereby mutations which on average have very little chance of producing an improvement that would be compatible with the metabolism of the organism would be eliminated. Similarly sexual selection can accelerate the process of natural selection, by pre-selecting, for example, those which are perhaps particularly brave hunters (➲ pp. 291 f.). Although here the direction of evolution may largely remain the same, its wastefulness and blindness is reduced. Despite referring to adaptation, the interpretation that the mediation of auto-selection may reduce the blindness of an adaptive process is, I think, still rather non-Darwinian.

Secondly, auto-selection always contains the possibility of autonomy. Since the evolutionary entity in question becomes one of its own causes, it may also internally turn evolution in a direction that, if judged in relation to the external environment, is not advantageous. From this external viewpoint, self-determination may sometimes appear as a constraint on adaptation to an external environment. Auto-selective processes may often have evolved as blindness reducing adaptations in the sense illustrated above, but because of the self-referentiality involved, they may have acquired a certain autonomy. If internal criteria were to come to dominate, by chance or through some other means, then simply those entities would survive which best fulfil these internal criteria. In this case the causes for selection are partly *sui generis.* In this sense autocatalytic circular causation[1240] and *autopoiesis,* opposed to passive adaptation to an external environment, should be acknowledged as playing a relevant role in evolution.

Throughout this work phenomena have been dealt with, which may be interpreted as auto-selective processes.

At the level of *individual morphology and genetic mechanisms* auto-selection is generally discussed under the keywords of internal constraints and direction. Starting from amidst the Darwinian paradigm, terminologically, these internal constraints and directions may also refer to certain variational processes, which I dealt with earlier on. I have already shown that – despite difficulties – it is generally possible and even necessary to distinguish between the internal and external causes of a trait, particularly

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[1240] An excellent treatment on the importance of such processes in nature is, for example, given by: E. Jantsch, *Die Selbstorganisation des Universums* (1979/1988), pp. 255 f.

if one wants to speak of adaptations to external environments in a reasonable way (➲ pp. 343 f.). Although this work did not clarify the differences between the variational and auto-selective causes of constraints,[1241] the main argumentation will be repeated here, because it has become apparent that both causes can be involved and that the given argumentation is equally applicable to either case.

Auto-selection in a similar way may play a role but not in respect to microbiological and genetic mechanisms (which we may distinguish from macroscopical morphological constraints). In this section I have already mentioned the repair mechanism that selects those mutations which are not expressed in the genetic code. Although this case is most appropriately regarded as an adaptation, as it has been treated above, such genetic auto-selective processes can also lead to constraints on the direction of evolution (as seen from the viewpoint of an adaptationist) or to an autonomous tendency of evolution. The exclusion mechanisms and auto-selective repair mechanisms might, perhaps, have prevented the evolution of a much more adaptive evolutionary code (➲ also pp. 381 f.).

Systemic individual selection provides an example of auto-selection at group level (➲ pp. 291 f.). In the detailed treatment of this case it has become apparent that many cases of hetero-selection at the level of individuals or of single genes may compose a system, which has new systemic properties. The system they compose may possibly have the additional property of stabilising a certain distribution of properties or a certain internal trend. This distribution or trend need not result in an adaptation for an environment external to the system as a whole. Based on the internal self-referentiality of selection processes as a whole, the system is auto-selective, and, for good or bad, may have a certain autonomy in relation to external selection pressures.

The most obvious class of such auto-selective systems of individual selection is *sexual selection* (above I gave different examples, and this interpretation can, perhaps, also be applied to evolutionarily stable strategies). Sexual selection, as has been mentioned before, does not necessarily have to be regarded as auto-selection. On the contrary, surprisingly Darwinians have often failed to acknowledge the auto-selective aspect of sexual selection or have not been concerned with sexual selection at all (➲ p. 395, small print). If one only regards individual organisms as being real it is actually consistent to also conclude that sexual selection is – in respect to individual organisms – external, and, hence, only another example of hetero-selection. But, following the above refutation of gene-Darwinian nominalism[1242], we are entitled to regard sexual selection at a certain relevant level of explanation as being a auto-selective process.[1243] If those organisms are, internally, strongly selected, because they follow an – perhaps externally non-adaptive – trend, only those organisms will survive that follow this trend and that mate with organisms which follow this trend. The autonomy of the internal tendency is, of course, restricted – a too strong internal tendency would simply end in the extinction of a whole species. Yet, it is plainly false

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[1241] At certain levels of explanation this distinction may not be reasonable anyhow. Particularly where any autoselection leads to constrained variation.

[1242] ➲ Chapter 9 on the transcendence of substance reductionism.

[1243] Sexual selection can be interpreted in this autoselective sense, ➲ pp. 291 f.

to assume that on all relevant evolutionary levels evolved characteristics are only moulded by an external environment as they may also be the product of such internal dynamics.

The behaviour, particularly learned behaviour, of organisms (or groups of organisms), provides us with a particular kind of auto-selection. Learned behaviour may change the way in which the parts of the body are used. Thereby behaviour could determine what features are actually adaptive and which are not. A change in behaviour may render formally adaptive properties to be particularly non-adaptive. This can be understood as a special kind of auto-selection, because here the organism contributes to the direction of evolution. It is particularly interesting that by such a mechanism learned habits indirectly exercise a systematic influence on the direction of bodily evolution and on the genetic makeup of an evolutionary line.[1244]

This effect is called the 'Baldwin effect', after the psychologist James Mark Baldwin, who – although not opposing Darwinism throughout – sought to infuse some mind and rationality into the evolutionary process. Like Baldwin, C. H. Waddington proposed a mechanism of genetic assimilation (1957) and Sir Alistair Hardy (1965) argued that innovative behaviour and habits in this way could influence the course of evolution, without requiring a violation of the Weismann barrier[1245].

Popper, when considering inborn central behaviour-controlling parts of an organism rather than learned features, argued that a change in the central parts is less likely to be lethal and, what is more important here, that changes in these parts direct the evolution of the executing parts.[1246]

Phenomena in which the central organismic propensity structure, or even learned behaviour, determines the direction of evolution (more than simply being selected themselves), were often regarded as evidence which was counter to strict Darwinism.[1247] Such phenomena, if explained as I have done so above, do not, I think, support Lamarckism in its strict sense; nevertheless neither do they support strict Darwinism. An emphasis on the active organism, on internal goals and on learning stand in contrast to the main message of unchangeably blind and passive adaptation to an external environment. Particularly if we aim at defining Darwinism as strictly as possible in order to reveal an evolution of evolutionary mechanisms, one will not subsume such a changed mechanism as being purely Darwinian. In respect to the criterion which is presently to be discussed, the Baldwin effect involves auto-selection in which the central propensity structure of the organism, and perhaps even its learning, and not only blind external selection, guides the direction of its evolution.

This Baldwinian kind of auto-selection, which is based on self-referentiality, may also lead to both, increased sight or increased self-determination – effects which were

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[1244] Critically see e.g., J. Watkins, *A Note on Baldwin Effect* (1999).

[1245] Mentioned by: P. J. Bowler, *Evolution* (1984), p. 321.

[1246] K. R. Popper, *Objective Knowledge* (1972/1979), Chapter 7; particularly p. 278.

[1247] G. Masuch, *Zum gegenwärtigen Stand der Diskussion.* (1987), p. 49. J. Schlüter, *Kritische Aufarbeitung des gegenwärtigen Forschungsstandes* (1987), p. 94. R. Nachtwey, *Der Irrweg des Darwinismus* (1959), pp. 171-173.

mentioned before generally. If organisms can find more advantageous ways of behaving through learning, the selection pressure caused by this behaviour, itself becomes changed to support the further evolutionary biological refinement of it. On the other hand there may be behaviour, which is itself so deeply build into the propensity structure of an organism, that it canalises evolution in this direction. The effect of which is that evolution tends to refine that behaviour, although, perhaps, different behaviour may have favoured evolutionary changes which would have been more consistent with the overall bodily endowment of the organism.

In this section I have justified the third criterion of our strict definition for a Darwinian process. It is part of the core of Darwinism to regard selection as external and as an opportunistic response to the moment. But if this is given, it has also been shown that both aspects of this criterion of our non-tautological definition are not always factually fulfilled. Paying considerable attention to the role of external and internal causation in respect to the second step of a Darwinian process, I have shown that not all evolutionary processes fulfil the Darwinian criterion of externality. If we understand Darwinism and non-Darwinism as the two extremes of a spectrum, instead of being the only two alternatives, then neither Darwinism nor the non-Darwinian position opposed to it – advocating inner dynamics as the only evolutionary force – appears to be generally right. Without aiming to diminish the role of hetero-selection, the claim of a universality of Darwinian processes has to be criticised. The necessary assumption of externality is not only problematic in respect to process-Darwinian economics, but also in respect to biological Darwinism itself. Instead the phenomena discussed here, rather point to an evolution of evolutionary processes – which already exists in biology.

d) The Evolution of Evolutionary Mechanisms

In this final section of this chapter on process reductionism, it is first argued, that, based on the results of the preceding sections, a theory of evolving evolutionary mechanisms is generally required. It should replace universal Darwinism, which regards the evolutionary process as being unchangeably blind, wasteful and externally governed. Secondly, it is discussed in detail how the emergence of evolutionary processes may become conceptualised, and how some cases of process emergence that we came across, are linked to the notion of autonomy. Since this chapter is only intended as a critique of Darwinian process reductionism and not as a full proposal for an alternative approach, it is only shown that such an approach generally proves to be necessary and, additionally, provides some concepts and examples helpful in imagining such an approach.

(i) The Necessary Concept of an Evolution of Evolutionary Mechanisms

Darwinism has been characterised by a materialistically transformed Newtonian-Platonic concept of an eternally given pre-existing law of nature (➲ e. g. pp. 168 f.) The ubiquity and unchangeability generally inherent in a Darwinian view of life, is fully expressed in some recent proposals, in which the Darwinian process is regarded in a strait forward way as "the universal solvent capable of cutting right to the heart of everything in sight."[1248] We have dealt with universal Darwinism in its gene-Darwinian and process-Darwinian forms in detail before (➲ pp. 205 f.). A Darwinian approach, be it applied to biology and repudiative of all other ontological levels, or also to psychology, economy or theory of science, entails, in either case, a theory in which the evolutionary mechanism is essentially regarded as being unchangeably a Darwinian process.

Our previous discussion of different criteria for a Darwinian process is based on a strict definition of such a process (➲ pp. 358 f). This definition avoids tautological justifications of Darwinism (➲ pp. 339 f.), and has been formulated in order to enhance our conceptual resolution and to make the possibly concealed evolution of evolutionary mechanisms detectable. A Darwinian process has been defined – for short – as a process of blind-variation-and-external-selection. A definition which, as I have shown, does no injustice to the essence of the Darwinian paradigm. A strict definition made it possible to regard Darwinism as one extreme of the dimensions of blindness of variation and the externality of selection (➲ p. 359). Only the externality of the selection process secures a certain adaptation to an external environment. Based on this definition, processes, as we have seen, may well be located somewhere between being blind or omniscient (➲ p. 368) or between being determined externally or internally (➲ p. 394). Hence, in this view a denial of radical Lamarckism does not necessarily imply Darwinism and *vice versa*.

In the preceding sections, we have discussed in detail to what extent actual processes fulfil these criteria. Although we partly discussed cultural processes, we did not patrol the borderlands between biology and the social sciences extensively. Although I regard culture as the most relevant change in the evolutionary process, here I focused on biology itself.[1249] Despite the relevance of process-Darwinism to other fields, the core of the Darwinian paradigm is located in biology and the alternative theory of an evolution of evolutionary mechanisms (transcending Darwinian processes) which I have suggested will be most controversial in this field.

The last sections proved that even in biology all the criteria for Darwinian processes, if applied in a strict way, are violated by actual evolutionary processes. It became evident that there is not only variation, but also true synthesis, that variation on many explanatory levels cannot always be regarded as being blind, that variation does not always remain equally wasteful, that selection is not always an opportunistic response to the moment and that there are auto-selective processes which do not necessarily lead to adaptations in respect of an externally given environment.

But given such processes which reduce the blindness and wastefulness of evolution and which gain some autonomy from external selection, it plainly follows that, according to our definition, evolutionary processes do not always remain strictly Darwinian. Evolutionary processes evolve themselves and can be changed, composed into new wholes or emerge completely new.

As far as they increase the sight of an evolutionary line, the processes which I have discussed already, like the re-use of adaptive building blocks, the re-shuffling and

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[1248] D. Dennett, *Darwin's Dangerous Idea* (1995), pp. 521, see also 21, 40, 42, 51, 133, 232, etc.

[1249] ➲ also e.g., pp. 365 f., 337 f., 401.

recombination of pre-selected genes, adaptive auto-selection etc., in my view, have presumably played a role in enabling an increased velocity of evolution, or better of particular evolutionary lines (➲ also p. 369). Such mechanisms, I think, made it possible to cross over maladaptive valleys which prior to that may have been unsurpassable parts of the adaptive landscape. Without elaborating upon this, it appears – and here I follow in the footsteps of a whole tradition of authors –, that the palaeontological record itself could well be interpreted in a way that would suggest that evolution in its early beginnings occurred at a slower rate than it did later on. The oldest fossils indicate that life started about 3.1-3.4 billion years ago. For a long period of about two billion years only prokaryotes, a simple type of unicellular organisms, populated the earth. After which eukaryotes, still single celled organisms with a more complex cell-structure, started to predominate. The first multicellular organisms emerged only about 640 million years ago.[1250] Then in many further steps the course of evolution seems to have speeded up somewhat.[1251] In my interpretation the apparent increase in evolutionary velocity is not only an irrelevant epiphenomenon, but appears partly at least to reflect changes in the evolutionary processes themselves.

Such a view may gain more plausibility through the use of an analogy using algorithms in information technology. Darwinian processes can be regarded as a representation of a certain algorithm.➲372 The same simple mechanism always becomes repeated. In information technology, evolutionary strategies have been modelled for technological problem solving as search strategies in an (multidimensional) adaptive landscape. A strictly Darwinian process of chance-variation-and-external-selection in these models indeed leads to some adaptation. But although a purely Darwinian process has the advantage of being very simple, and is still open to all directions, it has in most settings been shown to have the important disadvantage of being slow and resting on only local maxima.[1252]

It has been shown that many evolutionary processes are not Darwinian processes in their strict sense – strict Darwinian processes may even be rare. I have argued, for example, that variation rates at many levels are not always systematically blind. In this view many processes, which are often loosely said to be Darwinian processes, should, under closer scrutiny, not be characterised in this way. To elaborate a theory of the evolution of evolutionary processes in more detail, it will be important to disentangle the Darwinian and non-Darwinian aspects of the processes. In this way processes which are commonly accepted have to be scrutinised as to how far they change the wastefulness and the direction of evolution. Evolutionary processes generally have to be understood not as being externally and eternally given, but as evolving and themselves being partly inner properties of the evolving entities in question.

[1250] E.g., D. J. Futuyma, *Evolutionsbiologie* (1986/1990), pp. 365 f.

[1251] Ironically even the evolutionary trees given in D. Dennett, *Darwin's Dangerous Idea* (1995), pp. 86-90, could be interpreted in roughly this way.

[1252] See: Th. Blümecke, *Wunder der Evolution: Optimierung mit Evolutionsstrategien und genetischen Algorithmen* (1991). Cf. also: K.-P. Zauner, *Vorbild Natur. Biologische Viren unter dem informationstheoretischen Mikroskop* (1992).

Besides a reinterpretation of acknowledged evolutionary phenomena, other phenomena which would normally not be focused upon in this field need to become understood as evolutionary mechanisms in their own right; the mechanisms of duplication of complex genetic structures, evolutionary constraints and some neglected mechanisms of auto-selection provide good examples of this.

Generally, I am even inclined to take the somewhat Whiteheadian stance that whether a new type of entity has evolved (e. g. a species opposed to asexual reproducing single organisms only), or whether a new process has come into being, changing the speed or course of evolution is largely equivalent.[1253] Although one has to note that this parallel has some limitations,[1254] someone who accepts the synergetic emergence of new independent levels of organisation in respect to things, a view which is supported in this work as well (➲ pp. 248 f.), will not be startled by a similar emergence of processes.

For example the emergence of biological sexuality, not only brings a new entity into being, a species in the reproductive sense, but equally changes the evolutionary process itself. As argued elsewhere, this process can, be characterised by the recombination of pre-selected genes, a process which in part does not fulfil our strict definition of a Darwinian process (➲ pp. 378 f., 366 f.). Moreover, sexuality enables a bunch of other evolutionary processes, like genetic drift, founder effect or frequency dependent evolution.

Apart from considerations about the speed of evolution and about the, so to speak, Whiteheadian parallel of processes and things, which may render the view of an evolution of evolutionary mechanisms more plausible, it, as shown, in any case plainly follows from the exposed differences of actual evolutionary processes to strict Darwinian ones that evolutionary processes themselves evolve, transcending strictly Darwinian processes.

This general position suggests the possibility of an accelerating cascade of evolving evolutionary mechanisms, although the adaptability of these processes may sometimes be outbalanced by an increase of constraints throughout evolutionary time. However, the increased adaptability, for instance, of sexually reproducing spezies (the creation of species) may allow not only for more easily reaching adaptive local optima and corresponding particular adaptations, but it may allow for a quicker creation of evolutionary mechanisms. This idea builds on the idea of an evolution of evolutionary mechanisms differing from Darwinian processes elaborated here. But the idea of such a cascade of mechanisms in genetics and evolutionary biology needs to be elaborated in the future and may be a challenging task for future generations of biologists and philosophers.

In cultural development such cascades of mechanisms appear to be common. For example, in technology in the narrow sense, early computers (think of an abacus) were built using much simpler tools, and not much later we started to use programs for complex computers to design even more complex computers, machinerie or

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[1253] On the parallel of a truly Darwinian process and a truly atomistic replicator, ➲ pp. 218 f., 258 f.

[1254] A new kind of entity may refer to a new process of an old kind, only on another level. However, often the different levels will be linked and may nevertheless lead to new systemic properties.

programms. But aside from technological revolutions, also in our daily life such accelerations are ubiquitous; they occur and they are often intended to occur when one improves as different things as one's tools, concepts, macros, or simply one's furniture. Although it is an important and task to personally and politically evaluate for instance rapid technical accelerations, it needs to be acknowledged that cascades of accelerating prosesses seem to be not only part of our second nature, but appear to be essential to our first nature as well.

(ii) Process-Emergence, Circularity and Autonomy

The preceding sections have shown that the defining criteria of a Darwinian process are all violated by existing processes. Darwinian processes may nevertheless serve as a base line, against which more complicated and less blind processes can be measured.

This section is concerned with summarising the discussion of the different new processes considered earlier. In this section, the emergence of processes are characterised in a positive way and this is linked to different notions of freedom. Although the negative characterisation shown by the difference to Darwinian processes remains the ultimate criterion for the discussion of a transcendence of Darwinism, and although no general *positive* criterion for new processes is found (apart, of course, from the almost tautological aspect in which way the new process works has somehow to have a causal effect which is systematically changed), the differently elaborated ideas in this section may possibly contribute to a general theory of process emergence.

I start by discussing causal feedback or *circular causation.* This can be regarded as one possible condition for the emergence of new processes. To be cause of oneself (lat., *causa sui*) has been linked to the notion of substantiality. Here we are concerned with entities *partially* causing themselves. One may also argue that the properties found in such a partial self-causation, only reveal hidden previously given inner necessities. In regard to things, Kant argued that it is a precondition for the oneness of parts that they are mutually cause and effect for each other.[1255]

> This is discussed in the context of Kant's moderate teleological understanding of nature, in which the mutual interdependence of parts is understood as a precondition which is entitled to assume (as a regulative idea) that parts serve a certain purpose (not only lying in themselves). This had a general impact on romantic biology.[1256]

One may argue that new wholes can be formed by closing a causal circle, this means that they are formed by mutually relating entities which have not been causally related or only related in one direction before. If one also applies this thought to processes, the two independent linear causal processes, $A \rightarrow B \rightarrow C,$ and $C \rightarrow A,$ can be assumed to form a new whole, which would, potentially, contain new properties, if the feedback loop is closed: $A \rightarrow B \rightarrow C \rightarrow A$.

This concept of emergence is similar to that found, for example, in the later work of K. Lorenz. Generally, self-referentiality is fundamental to cybernetics, system

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[1255] I. Kant, *Kritik der Urteilskraft* (1790/1793/1799), orig. pp. 290-291.➲ pp. 80 f.

[1256] T. Lenoir, *Morphotypes and the Historical-Genetic Method in Romantic Biology* (1990), pp. 120-121.

theory and theories of self-organisation (➲ p. 152), by which Lorenz appears to have been influenced.[1257]

Lorenz in his book *Die Rückseite des Spiegels* (1973) applied such a emergence concept in an, I think, illuminating way, to organismic learning processes, starting with a treatment of the amoeba and ending with a treatment of cultural development. However, although the emergent learning processes, which have already been discussed may indeed be interpreted as parts of the evolutionary process, it appears to me that Lorenz does rather dissociate evolved processes from the evolutionary process itself. In any case Lorenz does not treat processes which are close to evolutionary biology and, perhaps, does not sufficiently clarify the relation of nested learning mechanisms in terms of their being part of this process.[1258]

> In general the proponents of the evolutionary synthesis have to a certain extent worked with the concept of emergence (➲ p. 137).[1259] They introduced mechanisms on the species level, which are now, as has been shown, underrated by proponents of gene-Darwinism. None the less, they have promoted the complete blindness of trials, which on different explanatory levels has been questioned in this work and but have not developed a concept of auto-selection (they even played down the role of sexual selection, which may be interpreted as a type of auto-selection.)

I see no reason why Lorenz's idea of new feedback loops should not be applied to evolutionary processes themselves.

Implicitly, this concept has been essential to the concept of auto-selection, as I have dealt with it above (➲ pp. 394 f.). We were concerned with morphological, genetic and systemic auto-selection. It has been shown, that these mechanisms can either lead to the systematic pre-selection of the adaptive direction or to an internally determined tendency which does not result in an adaptation to an external environment.

In this sense this type of process is linked with the possibility of *autonomy*. The circularity of the process may induce an inherent dynamic, which can have an independent influence on the further course of the evolution of the entity or the system of entities in question. Thereby, it is not only the speed of evolution that may be changed, but also the direction that can be changed in a way which need not be adaptive in respect to an external environment.

Here sexual selection well be discussed once more, which, in the interpretation of the current work is a particular case of auto-selection that may lead to non-adaptive trends and even in the long run may be able to sustain such an inner tendency. Above it has been outlined why such an interpretation of sexual selection is to be regarded as different to a strictly Darwinian one (➲ p. 395, cf. also: pp. 291 f.).

Sexual selection often evolves as an adaptation. In this respect auto-selective aspects which are involved in it may work to accelerate the work of hetero-selection.

[1257] K. Lorenz, *Die Rückseite des Spiegels* (1973/1777), pp. 48-50 (Lorenz regards this as an important subtype of emergence)

[1258] *Ibid*, p. 66, e.g., the evolved processes were always "bound to results of the trial and error method of the genome" (translation by the author).

[1259] E. Mayr, *The Growth of Biological Thought* (1982), pp. 63-64.

Even this, according to our strict definition of Darwinism, is non-Darwinian, since systematically this reduces the average blindness of trials. Sexual selection, selecting in an adaptive way, for example, those animals which are strong in combat, so to speak, selects earlier than natural selection does. In a population where sexual selection is developed it is not necessary that a huge mass of organisms are raised and nurtured, which only go on to have extremely bad chances of survival. Hence, the number of dead-ends gets reduced and in this sense evolution becomes somehow less wasteful and, in our understanding, less Darwinian. Moreover, species which have evolved the process of adaptive sexual selection may gain a certain independence from short term fluctuations in the environment, which would otherwise produce many blind alleys.

But the adaptive advantages of this auto-selective mechanism are linked to the possibility that this process gain a certain independence. From an adaptationist viewpoint autonomy would rather be described in terms of disadvantageous constraints. If *every* wrong path does not have to be tested, then some advantageous paths may also be missed. If the process of sexual selection produces counter-adaptive results it will possibly be counter-selected itself. But a counter-adaptive tendency to some extent and for a certain time is continued.[1260]

Moreover, sexual selection, interpreted as a kind of auto-selection, can even lead to a stronger form of independence. It might not only gain a certain autonomy which after a while will still be reduced by natural selection, but an autonomy with which to determine its own direction quite independently of natural selection. As an example I take the enormous antlers of palaeontological (and perhaps also present) deer, the existence of which represents a phenomenon which, historically, was important to proponents of inherent possible non-adaptive evolutionary trends.[1261] Let us assume that the remarkable relative size of the palaeontological species *titanothere's* antlers have evolved by sexual selection, be it by male combat or by female choice. In terms of natural selection, the enormous size of antlers may well be regarded as maladaptive. If one takes this as given, I think, sexual selection could have led to such an autonomous trend which is even maladaptive from the viewpoint of natural selection. I have shown earlier that sexual selection does not need to become reduced to a strength which would be suitable from the viewpoint of natural selection. The auto-selective process of sexual selection, could, up to a certain extent, take over and may itself determine the direction of the evolution of a given line. On average only those animals will be able to reproduce, that have followed the, in terms of natural selection, maladaptive trend to big antlers. In a way then it will only be these animals that are exposed to natural selection. If the process of sexual selection is strong enough, this

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[1260] Strangely enough even R. A. Fisher has conceded that: "The importance of this situation lies in the fact that the further development of the plumage character will still proceed [...] so long as the disadvantage [in natural selection] is more than counterbalanced by the advantage in sexual selection." In: *The Genetical Theory of Natural Selection* (first 1930), pp. 135-136. (Quoted in S. J. Frankel, *The Eclipse of Sexual Selection Theory* (1994), p. 182.

[1261] The concept of an inner momentum of change has been cardinal to orthogenesis as for instance advocated by T. Eimer. One main research interest of H. F. Osborn, another proponent of orthogenesis, was the evolution of antlers of the paleaontological mammal *titanothren*, which in the following is taken as example.

may lead to continuing inner dynamics, although natural selection may work against it. The process of sexual selection itself will not necessarily be reduced, because those organisms that mate especially with organisms with big antlers, obtain an advantage through mating with these organisms, since based on this very trend in the filial generation their offspring have an increased relative probability of reproducing. Both, the genetic basis of antlers and that of the preference of mating are stabilised by this tendency.(for a more technical elaboration of this argument, ➲ pp. 291 f.). If, however, such a trend becomes too maladaptive, and does not at some point become balanced (not even reduced) by natural selection on the level of individuals or groups, it is, of course, possible that the whole line becomes extinct. The species of *titanotheres* has become extinct – possibly partly for this reason. In this sense the freedom from natural selection, remains limited. But nevertheless, mechanisms could in this way have a certain inner autonomy, without the need for indirect dependence on natural selection.

In respect to such possible autonomous tendencies (and equally in respect to the mechanisms of reduced blindness) it is not only false but also irresponsible to claim – even if only meant as a popularisation – that the human limbic system, our emotional structure and hence[1262] our morals have "evolved by natural selection".[1263]

> Homo sapiens spend an exceptional amount of time and endeavour on their sexual lives and on matters of partner choice. There may well be much ground for autonomous tendencies here as well. Matters are actually even much more complicated in regard to humans because of the additional stratum of culture. Also at the level of culturally transmitted ideas (what I have called *logoi*), such autonomous processes may take place. For instance the idea of the Good may foster self-sustaining tendencies, which may not always be necessarily adaptive in respect of the outside world. (This may be due to the particular character the notion of the Good has, which cannot be discussed here.) Such autonomous cultural trends may then also have a downward effect on the, partly autonomous, biological feedback loop of sexual selection.

We have shown that feedback, the establishment of a partly self-referential causal circle, is one mechanism, which can lead to the emergence of processes with new properties. Moreover, emergent processes of this type can potentially not only lead to a less wasteful process of adaptation, but also to auto-selective trends, which do not have to be adaptive in respect to an environment external to the system in question. Kinds of auto-selection may even lead to permanent autonomous inner dynamics, which, up to a certain extent, are no longer controlled by natural selection.

Not all the processes mentioned in this work, which differ from the elaborated base line of a strictly defined algorithm of a Darwinian process fulfil (at least in its full sense) the positive criterion for self-referentiality (➲ pp. 409 f.). Apparently other changes also seem to qualify as changes in the evolutionary process.

We turn to the *class of processes which have been characterised by their adaptively reduced blindness of trials* at different explanatory levels (➲ particularly pp. 368 f., 336 f.; here I

[1262] Such a conclusion actually silently assumes an emotive theory of ethics.

[1263] E. O. Wilson, *Sociobiology* (1975), p. 3; *On Human Nature* (1978), p. 6, ➲ also footnotes 147, 161.

do not deal with the concept of constrained variation). Within this class one can distinguish between processes which have changed themselves and processes which are combined in such a way as to acquire new synergetic properties as a whole.

In respect to composed processes we may think of nested selection processes (I shall mention the part-whole relationships of processes below; ➲ *also* pp. 337 f.) Examples of nested selection processes were operant conditioning and, according to a certain theory, the neural development of organisms (➲ pp. 227 f, 235 f.). One may – opposed to the view supported here – assert that the biological process has, as a whole, not changed, since the underlying evolutionary process remains a Darwinian one. Although, if the processes are judged in isolation, this proves to be true, it does not remain so if they are judged in their natural unity. Taken as a whole, processes of compound nested selection, could much more quickly find adaptive optima. Special niches, which only exist as environmental fluctuations for a short period of time, can still also be used even if they do not exist permanently. Biological selection alone would not have been quick enough to find these niches, which for the basic biological process alone, would only lead to blind alleys. In this sense, I think, one has to acknowledge, that on some level this process involves a reduced blindness (➲ pp. 337 f.).

In respect to processes which have themselves been changed, the possibility and, even, plausibility of the evolution of processes with a reduced blindness of variation on different levels of the multi-level account of evolution have been discussed in detail earlier in this work (➲ pp. 377 f.). Even at the level of mutations, this is rendered plausible by the many phenomena which we treated in the different and quickly developing fields of genetic research: the heritability and selectability of mutation rates, transposable genetic elements, the pivotal role of repetition of gene-complexes in most complex adaptive structures, the apparently adaptive evolutionary integration of certain genes, the phenomenon of so-called concerted evolution, etc. (➲ pp. 380 f.). Taken together with our above dismissal of the tautological argument that any change has to be blind, it has been argued that it is highly plausible that, on this level too, variation is not actually always blind, but sometimes itself systematically adapted. One may, for example, think of building blocks, which are apparently useful in many respects and found in many adaptive genetic codes, in which quite different macroscopic properties are encoded. Those species which, through one of the mechanisms which I have mentioned and which are acknowledged today, have evolved a higher probability that these multi-purpose building blocks are copied within the genome, have an increased probability of evolving in an adaptive way, relative to other species which have not evolved such mechanisms and building blocks. Today genetic facts provide enough of a basis to assume – without thereby proposing a strictly Lamarckian theory – that mutations are often to a certain, but limited, extent themselves adapted. But the adaptation of variations implies a systematic reduction of blindness and an increased evolutionary speed in reaching a new adaptive optima.

It may seem that the preceding example of a new and changed variational mechanism, may entail a certain circularity, by which we originally characterised another group of mechanisms, that were dealt with previously. Repetition seems to be linked to circularity. Here we discussed the repetitions of complex structures which have turned out to be adaptive in many contexts. There is in fact a certain interaction between variation and external selection, but, it would, I think, be misconceived to regard this as a circular process in the sense I gave earlier. Here we are concerned with a *linear* repetitive causal process. None the less this iterative aspect has in fact played a role in the evolution of the changed properties. (A similar argument seems to me to be applicable to the above example concerning composed nested selection processes. Yet this cannot be elaborated upon here.)

Hence, such emergent processes (as long as they are adaptive[1264]) are not linked with the *autonomy* that I discussed before, i. e. with an inherent and possibly non-adapative tendency which is independent of selection by an external environment. But in another sense, processes, which I have just discussed, which increase the general adaptability and reduce the blindness of a certain evolutionary process, can also be said to be free.[1265]

In philosophy autonomy is often distinguished to imply two meanings the first is a negative notion of *freedom from* external determination, the second is a positive notion of *freedom to* do the things which are necessary. Above I have once more outlined that, even in biology, processes can evolve a certain negative autonomy from hetero-selection. It may be suitable to say, that, in a way, processes have also evolved a certain positive autonomy which still leads to an adaptation to an external environment, but which has become less blind in achieving this adaptation.

I am aware that the notion of positive autonomy in respect to ethics usually has crucial connotations, which are not fulfilled by such a simplistic application of this in biology and which still normally only refers to an adaptive necessity. But equally I agree with Jonas, that we should build the basis of the notion of autonomy into our basic ontology.[1266] Otherwise, evolutionary accounts, as shown in this work, will tend to sweep away the notion of freedom altogether (➲ on the natural fallacy, pp. 42 f.). Indeed, in respect to the level of human culture both aspects of autonomy may become combined. If in culture the notion of the Good (due to a certain inner reasonableness of this notion) or, likewise, more specific values, became the basis of an inner and autonomous self-replicating trend, then processes which in a less blind way lead us to do good – to follow these specific values – would fulfil the outlined positive criterion for freedom, without thereby necessarily referring to natural selection.

In the preceding sections, many more processes have been discussed, which are not dealt with here. Finally I mention a *class of mechanisms which are enabled by* the *aspect of synthesis in biological sexuality* that I dealt with earlier. I have discussed at several places in this work why

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[1264] An adaptational directed variation (for instance, an enhanced probability of the repetition of adaptive genetic building blocks), may also lead to an evolutionary constraint or non adaptive trend. Although such trends are in my opinion not as stable as those based on sexual selection, they still have a certain independence.

[1265] This, as shown, can be a property of an autoselective process as well. Strictly speaking both, processes of increased variation and processes of autoselection, can, at least indirectly, be linked with both types of freedom outlined below.

[1266] H. Jonas, *Evolution und Freiheit* (1984); *Organismus und Freiheit* (1973/1994), pp. 17 f., ➲ footnotes 128 f.

> evolutionary lines of sexually reproducing species could, on the level of the whole, be regarded as being less blind. It made it apparent that sexuality enables an evolutionary line to cross broader and deeper valleys of an 'adaptive landscape', than would be possible for lines of single asexual organisms,➲[1172] whose evolution in this respect is more closely modelled by a simple Darwinian process. It has been pointed out before that a Darwinian process in information technology is known to get caught at local optima easily.➲[1252] It has also been shown that such an evolutionary line not only becomes quicker at finding adaptive optima, but also changes the adaptive landscape itself, by, for example, rendering certain kinds of co-operation between individuals possible, which had been impossible before. Generally the phenomenon of sexuality, aside from its obviously Darwinian aspects, partly appears to point to aspects of positive freedom as well as negative freedom, since a quicker adaptation is partly secured and a certain inner tendency can also be involved.
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> The synthetic aspect of sexual reproduction is also linked to, or provides the basis for, many other processes, which may be said to partly transcend Darwinian processes in their strict sense as well. Here I only mention two of these mechanisms, which may be re-interpreted in this way: the part-whole relationship of the processes of individual and group selection and also the process of genetic recombination. They have both been dealt with before as involving a certain preselection and leading to a somewhat reduced blindness of evolution on some relevant evolutionary level.
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> The *part-whole relationship* of individual selection and group selection are somehow linked by sexual reproduction. Of course, not every adaptation on the individual level, as we have seen, is adaptive at the group level. But any adaptation at the group level also requires a minimal adaptation at the individual level (and *vice versa*). In this – limited – respect it might be possible to argue that individual selection – despite the possible differences with group selection that I have conceded – will often produce less radically absurd trials as a preselecting factor for group variation than blind chance alone. In this sense this combination of Darwinian processes might, at the level of the group, often lead to more adapted trials than mere chance trials. In this sense the trials at the group level may possibly be regarded as being of reduced blindness.
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> More clearly, the process of *recombination*, i. e. the cross-overs of chromosomes different parental organisms, – although actually remaining blind in some respects – have been interpreted as a less blind type of secondary selection. Only new genetic combinations, which at their particular locus have been pre-selected before, are combined. Although this recombination still involves a risk and some blindness, it is less blind than a process without such a preselection (➲ pp. 378 f.).

To sum up, it has become apparent that a theory of evolution of evolutionary mechanisms is generally needed. The strict definition of a Darwinian process has been taken as base line against which the differences in other processes can be measured. In this section the mechanisms elaborated upon earlier have been reviewed. Self-referentiality as an important cause of process emergence has been discussed (a proposal whose basis can at least be traced back to Kant). We have seen that in regard to both the main defining Darwinian criteria, that of blindness and externality, that processes can evolve and that this can be linked to proposed notions of positive and negative autonomy of processes.

9.4 Summary of the Chapter on Process-Reductionism

This chapter has been concerned with a refutation of the claim of universality, as found both in biologistic Darwinism and in process-Darwinism and which were elaborated upon in earlier chapters. The influence of Universal Darwinism seems to be increasing and D. Dennett has pointed out, while new waves of Darwinism keep coming, new protective dikes are busily being built always at the expense of the land on the inward side. Here I have supported endeavours to reverse this process, not by trying to build another dike, but by critically scrutinising the concept of a Darwinian process itself, especially in biology. This chapter objects to the transformed Newtonian-Platonic view of Darwinism which states that in its essence evolution can exclusively be described as a Darwinian process, which is itself eternal, essentially unchangeable and ubiquitous. I think that this view conveys a pessimistic message, which is also found in the work of Spencer: "But there is bound up with the change a normal amount of suffering, which cannot be lessened without altering the very laws of life."[1267] Although I mainly focus on biology, I think that through my critique of Darwinian process reductionism 'light will be thrown on the origin of man and his history'.

First, it has been shown that an application of process-Darwinian at different levels, as proposed by proponents of a Darwinian multi-level account, may lead to inconsistencies. Darwinian processes, whether in a part-whole relationship or whether nested, may, as a whole, have different properties to their parts. I have, in detail, have scrutinised the tautological aspects of pan-adaptationism and pan-selectionism. In these, presumably the most refined sections of the work, it is shown that pan-adaptationism and pan-selectionism can not be sustained if they are not defined tautologically. Based on the treatment of possible tautological aspects of Darwinism, a strict definition of a Darwinian process has been formulated. This definition has led us to a two-dimensional spectrum of theories, in which Darwinism in both dimensions can be regarded as an extreme pole. It follows, that if one denies strict Darwinism, one does *not* have to adopt strict Lamarckism or a romantic inner unfolding of evolution either.

Subsequently different criteria of Darwinism have been discussed critically, partly in great detail. It has been illustrated that variation in biological evolution can not reasonably be said to be always and in all respects to be ruled by blind chance (despite its undeniable 'short-sightedness'). Equally it has been shown that not all evolutionary processes are based on external selection, which is a precondition for adaptation to an external environment. Instead to some degree internal trends can determine the direction of the evolution of a certain line. Although essential for the validity of my argumentation, the complexity of these sections can not be reflected in this summary. However, it became apparent that the discussed criteria are all violated by existing evolutionary processes, most of which are violated on many levels. It is concluded that the difference between actual evolutionary mechanisms and Darwinian processes (in a strict sense) necessitates a concept of an evolution of evolutionary mechanisms. Finally, it has been discussed how the emergence of processes may be conceptualised, linking them to the two different notions of autonomy, which, in a way, can be said to have already been found in biology. Nonetheless, the notion of autonomy in respect to human beings is additionally related to ethics and morals.

[1267] H. Spencer, *Social Statics* (1851), p. 325.

In the previous chapter, substance reductionism was criticised and a multi-level account of evolution was proposed; in this chapter, partly along similar lines, Darwinian process reductionism has been criticised and a view of nature has been proposed which stresses the evolution of, to some extent, autonomous evolutionary processes.

Chapter 10: Towards the Transcendence of Selfishness

"Not only does man need the earth for his life and activity but the earth also needs man."

C. G. Carus, 1820.

"Nur wer Sinn sucht, wird Sinn finden."

Hans Georg Gadamer, 2000

This work on Universal Darwinism and its transcendence does deal not directly with ethics, even so it has some ethical bearings and represents an investigation that has also partly been led by moral intentions. Proponents of the theories I have criticised have actually claimed that these theories have a strong impact on ethics. Without intending to favour a naturalistic fallacy, one's ethics somehow appear to depend on one's ontological and metaphysical stance (and *vice versa*). It is important to ethics which entities exist, whether there are only genes, or also organisms, groups, species and ecosystems. It is likewise relevant to ethics to know whether the ontological framework only allows Darwinian processes to exist, or if it also allows new processes to come into being which are less blind or which may possess a certain autonomy and intrinsic direction.

The limits of gene-Darwinism in respect to the claim that it should be taken as an exclusive basis for ethics were discussed at the outset of this work. After later on having gained a deeper understanding of gene-Darwinism and process Darwinism in Part II and III, I criticised their substance reductionism and process reductionism at detail in Part IV. Our treatment *ex negativo* resulted in an approach which recommends different evolutionary levels and an evolution of evolutionary mechanisms.

Although the ethical implications of my metaphysical and ontological proposals have not been discussed within the main parts of the work itself, I, here at least, want to give a rough sketch of some ethical considerations, which may follow from the general spirit of the previous work. In the concluding outlook on *ecological idealism* (➲ next section) some more features of a corresponding metaphysics will be clarified. In respect to ethics, it appears to me that the view of nature suggested in this work leaves more room for ethics than, in particular, that of gene-Darwinism. Here only three aspects of ethical relevance can be sketched (and a sketch, of course, is not a fresco).

(1) The idea that we are, to a certain extent, *part of larger wholes* is a feature of many metaphysical systems. It has been a main purpose of this work to show the falsity of the gene-Darwinian claim that the ontological inventory is limited to single selfish

genes only. Without denying that even these sub-organismic entities exist to some extent in their own right, I have shown that strict germ-line-reductionism and gene-atomism, inherent in gene-Darwinism, are false and have to be transcended. It was demonstrated as being reasonable to accept the 'stuffness' of the organism and to some extent also to accept the existence of ontological wholes, like groups, species and even ecosystems. Although mainly concerned with biology, I, likewise, advocated the existence of different cultural entities.

Even in the biological stratum it has, for example, been shown that true individual altruism towards a group can under certain conditions be evolutionarily stable, whether it is based on structured population models of group selection which are more refined than those originally criticised by gene-Darwinism, or whether without ongoing group selection by a certain systemic constellation of individual selection processes (➲ pp. 284 f.).

I am aware that the claim that higher ontological levels have to some extent an existence on their own, is not only controversial but also at some point may perhaps even become dangerous. In this work I have therefore tried to steer a course between the Scylla of atomism, with its danger of venerating the ruthless selfishness of its elementary parts, and the Charybdis of holism, with its danger of rendering a rather totalitarian interpretation. Surely, we should not completely surrender to larger wholes, but we have and we should still have a feeling of responsibility for some of them, as we should also have one for ourselves.

(2) Another aspect of the view of nature advised in this work, which appears relevant for ethics, is the possibility of a notion of *autonomy* which is not incoherent with a theory of evolution.

It appears necessary to me that the notion of freedom already becomes build into our basic ontological concepts. In this point I differ from a Cartesian position and generally follow Hans Jonas,[1268] notwithstanding that I, of course, also favour a particular role for culture and consciousness. If a notion of freedom, essential to many ethical systems, becomes not built already into our basic ontological concepts, at least as a potential, I think that it might easily become swept away by approaches which demand consistency with such a basis.

In this work I have shown that even biological processes are not always reducible to natural selection. Processes can to a certain extent become autonomous. (Since process reductionism and substance reductionism was discussed along similar lines, the notion of autonomy may – in a Whiteheadian wake – be similarly applicable to both processes and substances.) The germ of that notion of autonomy, which we have found in biology, is, of course, not as refined as the notion we want to use in respect to culture and consciousness. An approach which starts in a bottom-up way will always have problems explaining the highest phenomena, which can partly only be understood if treated directly. But, I think, once a certain basis for such a notion and a general evolution of evolutionary processes itself is conceded, approaches that more

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[1268] H. Jonas, *Evolution und Freiheit* (1984); *Organismus und Freiheit* (1973/1994), pp. 17 f., ➲ footnotes 128 f., 1266.

directly deal with such higher phenomena in culture will also tend to be taken seriously more easily.

In this work, a basic notion of autonomy has been developed both in a positive and in a negative sense. At this point I focus on a notion of negative freedom (➲ generally, pp. 409 f.).

The positive freedom to do what is necessary in the biotic world will still normally refer to adaptation, here, however, it will be interpreted as the increased reduction of blindness and wastefulness of the evolutionary processes themselves.

I think the general idea that a reduction of blindness and wastefulness is possible may also somehow be of interest for ethics. But the general possibility of a certain directedness, may become particularly interesting if in cultural history it becomes linked to values partly transcending adaptation. This leads us to the second, negative, notion of freedom.

The notion of negative freedom from external determination can in a basic sense already be used in biology. It has been shown that processes can acquire a certain autonomous inner dynamic, which need not lead to adaptation to an external environment. In this sense processes could, to a certain extent, become self-governed and free from external determination.

Generally, this concept of inherent tendencies may also make intrinsic autonomous tendencies in culture more plausible. The cultural sphere in general may already appear to be free, but only because it is, as I also supported in this work, based on an informational stratum of its own. For example, concepts can themselves be stored, transferred and copied – without a change in biological information (cf. also the treatment of ‘memes’ and what I rather called ‘*logoi*’). Culture can thereby accelerate the adaptation process and reduce its wastefulness and blindness. Such tendencies have here also been regarded as being rather non-Darwinian.[1269] But this does not yet directly imply negative freedom from external, natural determination. Yet, it has been shown that such autonomous inherent tendencies even exist in biotic nature, particularly if auto-selection is involved. If this is conceded, it will, I think, become even more plausible for culture, in which there is such an additional level of information transfer above biological inheritance. Autonomous cultural tendencies in turn may have strongly influenced, for example through sexual selection, even our biotic nature.

The war-cry of some radical sociobiologists that morals have evolved “by natural selection”➲[1263] and that morals only serve survival, neglects the multitude of actual evolutionary processes within the biotic world, which involve autonomous tendencies; moreover it wrongly, I think, denies the possibility of autonomous dynamics in culture

(3) The *idea of the good,* in the most general understanding of the term is fundamental for most philosophical and religious systems. Here it can be regarded as being to a certain extent an autonomous idea, which itself regulates the organisation of other ideas. A proper treatment of the idea of the good, even if conceived roughly along such lines, would refer to the complex discourse of ethics itself, and hence lies rather outside the scope of this work. Nevertheless, I still dare to make at least some speculative suggestions on this topic.

[1269] Such tendencies may be regarded as being linked to positive freedom in its most basic sense. Cf. small print above.

The approach of an evolution of evolutionary mechanisms, which can , up to a certain degree, lead to autonomous inner trends, suggests, as mentioned above, that presumably even more autonomous internal trends exist within culture. Although this cannot be elaborated upon here, the view may allow for intrinsic values which, in turn, may have an influence on our daily lifes. A discussion of these trends would require to consider the historical character of human culture, the complexities of human reason as well as all the processes involved, in the case values evolve and change. My emphasis on the autonomy of values (understood in a broad sense) should not conceal the fact that values obviously also partly serve survival on the biotic level. Biotic survival is, in a way, a precondition for all other values. Yet, even survival, as I have shown in this work, need not be restricted to the interests of single selfish genes (➲ point one) and, moreover, values may also achieve this survival in a rather non-Darwinian, less wasteful, way. Values may lead, for example via sexual selection, to the effect that properties which are favourable for the group become evolutionarily stable without necessitating permanent group selection. But it is likewise plausible, in an analogy to the autonomous processes even in the biotic sphere that I have already discussed, that values can also acquire some autonomy from adaptation to an external environment. It is, for instance, widely held that one should value the absence of pain or the pursuit of happiness as being positive. This is the case – at least to some extent – even if these values no longer serve survival (otherwise the pains of those who are dying should not bother us).

Autonomous values, however, are not unrelated to each other and often acquire their autonomy not only by direct auto-selection, but by being related to what we regard as being *good*. The abstract notion of the Good may be regarded as the supreme value towards which other values could become directed.

But how does the notion of the Good come into being? Only a few possible aspects can be mentioned here. Early on this notion may have at least primarily served adaptive purposes at the biotic level. It may have served to secure group cohesion or social exchange etc. The notion may have also been linked also with advantages it gave to the members who fulfilled the culturally and flexibly defined values of prehistoric societies. But one may also think of a certain inner stabilisation and autonomy of such a trend from external criteria, along similar lines, as it has been discussed in regard to sexual selection before. In culture, of course, the process of increasing autonomy will presumably have been much more refined, based on aspects of our rationality and certain processes which only appear on the level of culture itself. For instance, open discourses, on how things *should* develop seem to necessitate, at least, a very simple version of such a notion: it is actually difficult not to agree that we should organise our relationships or our society in such a way as good as possible. Even most dictators – who seem not to have relied on open discourses – often have tried to justify their rule as being good. However manipulative such discourses on what is good sometimes may have been, the notion of the Good somehow refers to a search for a common perspective (➲ pp. 423 f.).

The more concrete aspects of particular understanding of the Good that certain individuals or groups hold, can, I think, also be regarded as a unification of all the more particular values. In this perspective, the Good is the hypothetical and always changing point of synthesis for all values which are regarded as being positive. The notion of the good, then, would, like the single values from which it draws, refer to survival aspects and equally to some autonomous tendencies, such as the afore mentioned value of the absence of pain. Such a synthesis would, of course, not have to be understood as a mere additive list of values, but a complex and self-referential (reflective) process which is based on all our cognitive-emotional capacities, which are in turn strongly moulded by the notions and procedures that we have learned. Our rationality and all involved processes have their own inner necessities. (The concept of selfreferentiality and multitude of processes will, perhaps, be plausible if one adopts an approach advocating the evolution of evolutionary mechanisms.) The good in this concrete sense is always constructed anew and is based on the multitude of processes, which in its most developed form may be called reason or wisdom. The notion of the good thereby transcends the particular autonomous tendencies, values and concepts from which itself draws. In this respect I agree with Moore: the notion of the Good is, once established, irreducible.

But how does the resulting notion of the Good again have an effect on the values which had been given before? Even values which do not represent an autonomous trend at all (which are exclusively based on hetero-selection) need not refer to the natural criteria of survival alone, because, if a general and partly autonomous (partly auto-selective) trend of the Good is established they may refer to this trend. This trend may constitute their new environment. Values within a general cultural development may become selected because they serve the general tendency of the Good, which in turn partly serves survival and partly the particular autonomous tendencies involved. In this sense the Good would have become, to voluntarily misuse a Kantian term, a '*regulative idea*'.

Generally this work is open to very different conceptions of the Good; I distinguish three types of approaches which are in principal compatible with the proposed view of nature.

(a) *Relativistic (normative) subjectivism*. Approaches which I denominate in this way, do not deny the causal force (shown above) of what is regarded as being good – in this weak sense they remain normative. They may additionally even hold that there are certain standards of the good within an individual or a community. In the above outlined understanding, the notion would still refer to a certain hypothetical point of synthesis for all the tendencies which are actually given. Nevertheless, this approach does not claim that this good refers to any *objective* truth.

(b) *Relativistic objectivism* likewise acknowledges the possible multitude of forms, but, nevertheless, still favours a logic of forms *(eidos)* which is objective. A general stress on form, reminiscent of Aristotelian or Platonic approaches, may be coherent with my rather hylomorphic definition of entities (➲ pp. 248 f.). Although in such an approach it would be argued that different structures may have their own optimal form, these ideal forms are still objective for each case. For example Aristotle understands rightness in an objective but still situational way. More practically one may, for instance, say that, *if* organisms have evolved feelings, consciousness, and a notion of the Good, it *then* will be a necessary ethical truth for them that the prevention of pain is a good in itself (which to some extent transcends mere survival). In such a formulation the objective law of form is located in the if-then relation, whereas the relativistic pluralism is found in the different possible premises.

(c) *Universal objectivism* could still possibly argue that the actual difference in the organisation of our highest values may be due to our ignorance. If this view should become possible in a context accepting evolution, it is necessary that the diversification of beings, which is obviously a basic phenomenon in biology, could become transcended on some level. The concept of the evolution of evolutionary mechanisms, developed in this work, renders it at least possible that on some level of cultural organisation it is not only diversification but also synthesis that may become cardinal. Even Popper argued that the process of evolution, understood as a process of knowledge acquisition, in the cultural quest for truth enters into a new mode, which does not lead to the diversification of opinions, but tends to unite them into one common stem.[1270] One may also speculate that such a cultural process, which leads to synthesis, had in evolution one time also to come into being, particularly if one considers the concept of processes of increased sight and self-referentiality as they are dealt with in this work. It may be possible to make plausible the idea that one day evolution needed to produce beings with feelings, consciousness and reason. These beings in their accidental properties would possibly differ considerably from humans, but certain values may be essential to any entity with such basic properties. For instance the partly autonomous value involved in the reduction of pain and the pursuit of happiness, may, in this sense, be regarded as being preordained. I think, however, that such a position could only possibly be made reasonable in respect to the most general ethical concepts that we may hold,, like, for example, the *a priori* concept of Kant's categorical imperative, or, perhaps, a general religious or Christian, love commandment.

These three approaches need not to exclude each other but, if each approach is applied to different phenomena, they may also become combined. It may, for instance, be plausible to combine the third view, applied to the most abstract aspects of the notion of the Good, with the second (and perhaps the first) one, if applied to more specific aspects. I do not want to weigh these different options here against each other, but only aimed to point out that they may all more or less be compatible with the view of nature as exposed in this work.

In any case it appears plausible that values and our understanding of the Good plays part in moulding the actual world (At least in the second and third case this may even be called *metexis,* ➲ pp. 71 f.).

None the less I finally want to consider an aspect of the notion of the Good which, in my view, is in any case essential to the notion itself. (Without discussing it here, this, perhaps, involves a certain inclination towards one of the above positions.) The notion of the Good is in my view tied to a search for *transcending a mere subjective position*. Although our ethical considerations will always start from a subjective or culture-specific viewpoint; a very property of the notion of the Good appears to be to aim to transcend these specific viewpoints. Although it is essential that existing internal autonomous tendencies are considered and possibly valued, it is, in my view,

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[1270] K. R. Popper, *Objective Knowledge: An Evolutionary Approach* (1972/1979), pp. 262-263.

equally essential for ethics to search for a more general viewpoint. Ethics itself can even be understood as the quest for such a viewpoint in respect to the normative aspects of the world (as ontology can be regarded as being such a quest in respect to the descriptive aspects of the world). Although Kant is concerned with what he called the "moral law *within me*"[1271], his categorical imperative can be understood to entail such a search for a viewpoint on the Good which is as general as possible; the maxim one ought to search for must equally be a possible principle of a *general* legislation. The scope of this generality is in principle unrestricted. The most general viewpoint is the view from nowhere or from everywhere. Such a hypothetical objective viewpoint is compatible with the acknowledgement of the existence of individual or cultural subjectivity.[1272] The objective viewpoint which is sought after, points to something like what Rawls has called a 'veil of ignorance'[1273]: while determining what is just and good, we try to abstract from the particular role we find ourselves in. Such a position does not need to deny that there are different inherent tendencies, which may also come in conflict with each other. Such a basic position does not entail a particular theory of justice, such as for example egalitarianism. These more concrete theories are linked to our further ontological, metaphysical and ethical positions. Likewise, this view from nowhere does not necessarily imply that we are personally responsible for everyone alike. Our personal duties may well be linked to the role we actually find ourselves in. Such a position only assumes that we try to determine what is just or good independent of our actual own position in the world.

But even if the notion of the common Good entails such a search for an impartial evaluation, the actual starting points of our search for the Good, and even the way in which we construct the world, will differ. None the less, it is of relevance whether one seeks impartiality or not. Such a quest implies a certain openness towards the Other. In a still different way also evolution from its outset is also not only directed towards *self*-preservation, but is open to the Other. Becoming, understood as a dialectical resolution (*Aufhebung*) of being and not-being, is not self-preservation, but self-transcendence. This becomes, in a changed way, even more so, if, in culture, the process of self-transcendence becomes directed by the notion of the good.

After much hard analysis in earlier chapters, in this short chapter only some thoughts were sketched in as to what respect the ontological view that has proposed here may have bearings on ethics and the general possibility of ethics. I, likewise, want to end this chapter in an open and slightly speculative way. It appears plausible that we are to a certain degree free to determine our own course of evolution and historical development. We are, as Sartre expressed 'condemned to be free'. But we are not blind, the light will lead us out of the dark to a better idea of the Good. In order to determine the meaning of this notion constantly anew, we have to critically take into account and assess the treasures of our philosophical and ethical traditions. This has always been one of the primary tasks of philosophy. Contrary to some

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[1271] I. Kant, *Kritik der praktischen Vernunft* (1778/1990), pp. 161-162, org.: pp. 288-289 ('der bestirnte Himmel über mir und das moralische Gesetz in mir').

[1272] Cf.: Th. Nagel, *The View from Nowhere* (1986), pp. 3 f.

[1273] J. Rawl, *A Theory of Justice* (1971/1990), pp. 159 f.

verdicts passed on it, philosophy is far from being dead. If it were, its renaissance would be required.

Summary and Outlook – Towards Ecological Idealism

This work has been concerned with the historical understanding of gene-Darwinism and other Darwinian paradigms, with the exposure of Universal Darwinism and finally with a critique of the different types of gene-reductionism and Darwinian process reductionism.

In this last section, the work is first placed in a broader philosophical context. Then its contents are summarised with a particular focus on the work's last part. Finally an outlook on ecological idealism is sketched out.

Beyond the Two Cultures?

With respect to the general intellectual context, this work can be regarded as being concerned with the gene-Darwinian approach to re-unify the so-called 'two cultures' (Snow) in a downward-reductive way. The phenomenon of two cultures, which are either concerned with the natural or the cultural world, goes back to Cartesian dualism which, in general, moulded the discourses of modern philosophy. It has been pointed out in this work that Cartesian dualism itself has even been influenced by a hidden Christian agenda regarding the human as a free *alter deus* and the physical world as a law governed, created *machina mundi* (➲ pp. 74 f.). In modern times the concept of *Machina mundi* has become increasingly understood in a *hylomorphic* sense, but in a mechanistic sense of matter in motion.

There have been many attempts to re-unify what only later became called the 'two cultures'. Often these attempts have been undertaken in a downward-reductive way. Materialism asserts that everything could be reduced to matter in motion and, perhaps, a few basic physical laws of nature. In this work we have been concerned with the biologistic claim that the social sciences and ethics can and ought to become reduced to biology and that these disciplines ought to become disciplines of evolutionary biology. The discussed radical paradigm of gene-Darwinism resembles earlier materialist approaches not only in its harsh downward reductionism, but also in its atomism and its understanding of laws of nature. Gene-Darwinism claims a thorough gene-atomism, in which single genes alone are the ultimate units of selection and all other seemingly existing layers of organisation are only their ephemeral vehicles. Moreover, gene-Darwinism (and process-Darwinism alike) advocates that Darwinian processes are the only and essentially unchangeable evolutionary processes. As elaborated in this work, Darwinism in general can be understood as materialist transformation of a Newtonian-Platonic understanding of laws of nature, in which the laws of nature, and particularly the law of natural selection, are still regarded as eternally given. A force acts on organisms,➲[711] which remain the blind and passive objects of evolution.

Although I appreciate the aim of formulating unifying ontological frameworks, I think there is some truth in dualism as well, at least in the limited sense that consciousness and culture are hallmarks of the human being and that they are linked with a particular degree of sight and autonomy. Only because of this can human beings truly be characterised as having attributes like *homo symbolicus* (Cassirer), *homo metaphysicus* (Schopenhauer), or *homo politicus* (Aristotle). Any simple reduction of one realm to the other bears difficulties and the danger of neglecting the specific character of the other realm.

However, instead of defending the autonomy of consciousness and culture, I have in this work analysed radical gene-Darwinism, which is normally engaged in biologising these concepts. Instead of ignoring biology or pursuing the downward reduction of all layers above selfish genes, here I try to take a third way in criticising gene-Darwinism in order to achieve a paradigm which is, firstly, more suitable for biology itself and, secondly, also provides a better ontological basis for cultural freedom and ethics. Hence, although I also have treated process-Darwinian explanations in culture, I have been mainly concerned with biological questions.

This work generally suggests that an evolutionary theory of evolution is needed. Without denying the existence of selfish genes, it has proved impossible to reduce all evolving entities to simple selfish genes. Likewise, without denying the existence and importance of Darwinian processes, the Newtonian understanding, still silently inherent in Darwinism, that the laws of nature do not essentially evolve, can, if based on a strict definition of Darwinian processes, not become sustained. A truly evolutionary theory, in which the processes of evolution are not static, is required. Apparently, new processes evolve which are not as radically blind and externally governed as it has to be assumed of Darwinian processes. It is shown that processes already become autonomous and self-determined in the biotic world.

> If Darwin – as, for instance, Depew and Weber have suggested – can adequately be regarded as the "Newton of a blade of Grass" (an originally Kantian term), not only for Darwin's importance but also because of his passive understanding of organisms on which external selection is acting, it appears to me – far from intending to belittle the great contributions of Darwin – that still an 'Einstein of a blade of Grass' is needed to come. Einstein has shown that the external categories of space and time are themselves not completely unchangeable, but are object to the structuredness of the physical world. Likewise, it appears that blind Darwinian processes are not eternally and externally given but to some extend can be said to evolve and change themselves.

Summary

This summary, like this concluding section in general, focuses on the last part of this work. The earlier parts are rather briefly mentioned. For a more detailed summary one may consult the summarising remarks at the beginnings or endings of most chapters. Likewise, the main line of argument has also been outlined in the introduction.

In Part I, Chapter 1 deals with the description of sociobiology and as such pays attention to relevant sub-theories. At that point the distinction between the subject area and the paradigm of gene-Darwinism is only briefly mentioned. This distinction is clarified in the further course of the work. Nevertheless, even in this chapter it is pointed out that the central theories of kind selection and reciprocial altruism need not necessarily be interpreted in a strictly gene-Darwinian way.

In Chapter 2 the claim to biologise morality, as is often found in sociobiology, is discussed. It is argued that this claim, if taken seriously, would not only lead to a neutral acknowledgement of our biological nature – to which, no doubt, sociobiology can contribute – but to a dismissal of what, from quite different viewpoints, has been developed as 'ethics'. If one does not dismiss ethics altogether, a, so to speak, *biological* categorical imperative, conceived exclusively along gene-Darwinian lines appears to follow from denial of any ethically relevant entity above single selfish genes and of any evolutionary process aside from natural selection. It is argued that such an account needs to result in a veneration of the prudent, but unconstrained, ruthless egoism of genes.

In Part II, the historical part, Chapter 3 outlines pre-Darwinian conceptions of nature in the history of philosophy and early biology. Pre-Darwinian concepts of evolution have also been mentioned. This chapter provides the background to later definition of Darwinism, allowing for the contrast of Darwinism with other philosophical and biological traditions.

In Chapters 4 and 5 an account of the internal and external history of Darwinism has been given. Chapter 4 on the inner-biological theoretical and empirical appeal of different Darwinian sub-paradigms has revealed that what is often broadly called 'Darwinism' is not as uniform as is often assumed. This account of different Darwinin paradigms provided one of the reasons for the endeavour to formulate a strict, but still appropriate, definition of a Darwinian process in later chapters. In this chapter, the comparason of different sub-paradigms allowed to work out what the essence of gene-Darwinism.

Chapter 5 investigated the external historical influences on biological Darwinism and its sub-paradigms. It has been shown that Darwinism developed in intense interaction with the more philosophical *Zeitgeist* and with specific ideas from theology, physics and economics. The historical sketch suggests, that – without denying the role of inner-biological developments – biology may be conceived as being in part a historical *Geisteswissenschaft*.

In Part III on universal Darwinism, Darwinian processes in many non-biologistic subject areas have been laid bare. This has been done partly based on the inquiry into the historical interaction of Darwinian ideas in different disciplines. In Chapter 6 two types of universal Darwinism are distinguished, biologistic Darwinism, at best exemplified by gene-Darwinism, and process-Darwinism. These approaches regard Darwinism as a new alkahest, a universal solvent to understand any kind of knowledge generating process. Universal Darwinism is often not only advocated factually, but metaphysically, arguing that all knowledge acquision processes, like mutation, trial-and-error learning and theory creation are in principle Darwinian, they are necessarily based on natural selection in the broad sense, involving blind conjectures and external selection. It is argued that this position is (implicitly or explicitly) bound to the Humian problem of induction and Popper's negative solution to it. It results in the claim that, in principle, any mechanism of knowledge acquisition can never transcend blind guesses. This view is critisised at the point at which it is set out (and in more detail also later on in this work). It is contended that this argument would be justified only if one had already *defined* that any new occurrence needs to be totally unpredictable. The resulting true but empty tautology, claiming that nothing completely unknown can be known in advance, is not at issue. However the interesting questions at issue are not plainly tautological, like whether change may be predicted in advance with a (rational) probability above chance. Although Hume's problem of induction runs deep, it is argued that this is partly an empirical and not merely a theoretical question, involving the option that universal Darwinism is false.

In Chapter 7 a sketch is given of how Darwinian algorithms have actually been applied in different subject areas outside of biology. It is pointed out that there are not only structural similarities between, for instance, random-mutation-and-natural-selection processes in biology, trial-and-error learning in psychology and Popper's falsificationism, but also that such processes found in several subject areas have been partly criticised along similar lines. This discussion contributes to the later, more detailed discussion of the possible tautological aspects of Darwinism particularly in biology. This chapter provides the basis for the subsequent discussion of substance reductionism (as found in gene-Darwinism) and process-reductionism (as found in both gene-Darwinism and process-Darwinism).

In Part IV different types of substance reductionism and process reductionism are discussed. In two chapters the criticism of reductionist tenets results in suggestions for a multi-level account of evolution and an approach emphasising the evolution of evolutionary mechanisms.

In Chapter 8, the first section concerns reductionism in general, the second gene-atomism and the third germ-line reductionism.

Discussing reductionism in general, first reduction is disentangled from explanation in general: reduction explains wholes by their parts, without attributing an genuin causal properties to the wholes. For reasons of clarity one may call this 'downward reduction' (one may also think of upward reduction). The epistemological notion of downward reduction is linked to the ontological notion of (eliminative) materialism. I show that materialism leads to physicalism, but that modern physics does not at all support a simplistic concept of matter in motion, which traditionally had been central to materialsm. The next sub-section, which is pivotal for the general case against downward reductionism, it is argued that the modern understanding of substances, which interpretes wholes as exclusivley being made up by their parts, is misconceived and turns out to be inconsistent. Besides this objection, I positively propose a classification of different ways of explanation which would involve relations and structurally analogous cases as well. From this perspective substance emergence needs not to be linked to complete unpredictability, which is otherwise entailed by occasionalism and, perhaps paradoxically, prevents the possibility of process emergentism. Finally, the general inconsistency of biologism with downward reductionism is discussed and I advocate that biologism interestingly involves a subversion of the very idea of downward reduction.

In respect to gene-atomism it is, firstly, argued that the size of a genetic 'atom' should not be interpreted in a tautological sense, meaning simply any stretch of DNA or any egoistic strech of DNA. Although such a tautological understanding seems may have immunised this view against criticism, a closer analysis reveals that selfish genes are actually taken to be relatively short sequences of DNA. It is argued that despite the meiotic shuffle, it is nevertheless reasonable to accept the existence of higher-level genes (existing in a probabilistic sense), which, due to their synergetic properties, can be said to have causally a top-down impact. Synergetic properties alone, however, do not necessarily lead to stable larger wholes. It is conceded that higher-level units may, under certain conditions, become subverted by selfish parts (here genes) that do not contribute to the advantageous wholes. Even so, it is also showed that in certain populational constellations higher-level genes may be evolutionarily stable and even increasingly come to dominate the population.

Still scrutinising gene-atomism, another tautological fallacy is discussed, namely that of defining any surviving gene as being selfish. According to such a definition even genes which favour radical group altruism, and possibly survive through group selection, would, absurdly, be redefined as being selfish.

Continuing the discussion of gene-atomism, I consider different possibilities of how genes serving the good of the group can become established and evolutionarily stable. The proposal of 'systemic individual selection' is considered, according to which individual selection processes may occur in combinations that stabilise properties which would otherwise be subverted by selfish genes. Once such a system becomes established, for instance, by group selection, such a system is stable against subversion from within by selfish genes – without the necessity of continuous group selection. Moreover, developing on the proposals of Sober and Wilson, it is shown that refined structured population models, including semi-isolated groups of mixing individuals, can lead and stabilise evolutionary properties serving the common good. Gene-Darwinism has correctly pointed to some problems of simple models of group selection, but has gone too far in claiming that such models are never viable at all.

The final section criticising gene-atomism deals with selection on the level of species and possibility multi-species systems up to the level of ecosystems. Although species have some unique properties, I advocate that many different levels of evolutionary organisation seem to have causal relevance and, additionally, under certain conditions, cannot be subverted by selfish entities on a lower level. Gene-Darwinism has, in my view, been right to point out the existence of sub-organismic units of selection. Even so it is argued here that the existence of evolution at a larger level of organisation can be shown. In this sense the current work rejects the strong nominalism of gene-atomism.

The next section is concerned with germ-line reductionism. First, it is argued that the Weismann barrier does not imply germ-line reductionism. Although I refer to some authors who recently have criticised the Weismann barrier, I here simply adopt the standard view and take Weismann's so-called 'central dogma of microbiology' as given. Nevertheless, it is reasoned that germ-line reductionism has to be seen as a particularly radical gene-Darwinian interpretation of the central dogma, regarding phenotypes as mere vehicles of the genes. After introducing the general concepts of what is called 'information' and 'exformation', it is contended that phenotypes are not reducible to genetic information alone but necessarily rely on exformation. Although exformation is only indirectly altered, it has to be accepted as a cause. For instance, some properties of organisms are not directly stored in the genes but stored for instance the material used as building blocks (reminiscent of *causa formalis*). These causes (forms) have their own necessities and can favour a certain direction or lead to certain evolutionary constraints. It is argued that morphological and functional constraints, albeit based on genetic information transfer, are a causal factor in their own right. I additionally advocate morphological fields (cf. Goodwin), external memory (still relying on genetic information transfer in another evolutionary line) and a partial revival of morphological taxonomy. (Cf. the summary at the end of that section.)

Overall, in Chapter 8 several aspects of downward reductionism have been discussed in depth, downward reductionism in general, gene-atomism and germ-line reductionism. As an alternative several proposals have been made including a different understanding of substance and explanation; a multi-level account of evolutionary entities and a view whereby phenotypes have a causal importance in their own right.

In Chapter 9, process-reductionism, characteristic of both gene-Darwinism and process Darwinism, is criticised. Process reductionism is a hallmark of Darwinian metaphysics.

In the first section it is pointed out that if Darwinian processes are applied on many ontological levels, as claimed by general process-Darwinism or by (inner-biological) multi-level Darwinism, processes will deviate from a purely Darwinian view. Combinations of Darwinian processes taken as a new whole may have quite non-Darwinian effects.

In the next section, which is perhaps the most refined one in this work, two tautological arguments which are sometimes implicitly present in Darwinian arguments are scrutinised. Firstly, I discuss tautological aspects of pan-adaptationism linked to the ‘survival of the fittest’, understood in the sense of a ‘survival of the survivor’. I analyse different notions of fitness and how far particular theories on what will actually survive can reasonably be called Darwinian. It is concluded that pan-adaptationism is either based on a tautological argument or it is plainly false. The concept of adaptation, if understood as an increasing fit to an external environment, is, however, not a tautology. Another discussion deals with possible tautological aspects of pan-selectionism along similar lines and provides the basis for a strict non-tautological definition of Darwinian processes.

To prevent tautological aspects in the definition of Darwinian processes subsequently Darwinian processes are defined in a strict way. Additionally, such a definition renders a possibly concealed evolution of evolutionary mechanisms detectable. A Darwinian process is, for short, understood as a process of blind-variation-and-environmental-selection. In a next step, it is argued that Darwinism according to this definition turns out to be an extreme on the two dimensions of blindness of trials and externality of selection. In this understanding a refutation of, for instance, radical Lamarckism or predominantly internally directed evolution, as favoured by romantic biology, does not necessarily entail Darwinism and *vice versa*. It is essential to my argument that there can be positions between these extremes.

In the further course of Chapter 9, it is shown that different defining criteria of Darwinian processes are not met by many actual processes – even in biology. Besides diversification, synthesis becomes an important factor of evolution in its own right. It is advocated that variation needs not always to be equally blind and wasteful but may gain a certain sight. Building on the earlier argument that variation should not be regarded as being blind by definition, variation may well exploit the existence of inner or outer continuities. It is claimed that evolutionary variation is actually not always *totally* blind. But it has also been contended – without thereby promoting Lamarckism – that, based on our present knowledge of genetics, it appears reasonable to assume the existence of the variation of reduced blindness even in respect to mutations. The arguments discuss genetical phenomena, like mutation rates, transferable elements, or the role of repetition and selfiteration. It is argued, for example, that intricate genetic building blocks are often repeatedly found in quite different complex adaptive structures. It appears plausible to assume a certain enhanced fitness of integrating such building blocks, since it is apparent that the involved complex adaptive structures could practically never been build from scratch by single blind point mutations. A repetition of certain building blocks, relative to radically blind chance trials, could be assumed to have in average been internally advantageous relatively to the creation of a total random mix of genes. This, however, does not entail that these mutations are not mostly lethal as well, as hoped by early mutationist. Evolution only shows that they in average have – relatively – an enhanced probability of leading to advantageous complex mutations than single radically blind trials. Additionally, the existence, of adaptive dimensions (perhaps even adaptive directions) is suggested, not only in respect to microscopic structures, but also in respect to morphological properties. However, if one conceded that there are – internal or external – dimensions of variation that are on average more adaptive than others, it becomes, based on the proven heritability and selectability of both of mutation rates and transposable elements (and other outlined mechanisms), highly plausible that to some degree also mutational variation is not totally blind, but may, to some extend, be adapted itself.

Furthermore, Darwinian hetero-selection is contrasted with the suggested concept of auto-selection, which can either lead to less blind evolution or to inner autonomous dynamics. Evolution based truly on auto-selection, like, as I would argue for instance, in many cases of sexual selection, needs not to lead to an adaptation to an external environment, but to autonomous developments.

In this work proposals are made how (ultra-)Darwinism should be transcended, mentioning many known mechanims which need to be interpreted in a novel way, leading us towards an alternative view of nature. However, this work does not provide a full positive systematics of this approach. In the concluding section of Chapter 9 at least some aspects of the resulting alternative idea of an evolution of evolutionary mechanisms are sketched in a more positive way. Once more different ways in which new processes can evolve by being combined, changed or by emerging completely anew are summarised. Darwinian processes, however, are accepted to provide the baseline against which deviations of actual processes are measured. The role of causal feedback circles for the emergence of new processes is considered.

Finally, the idea is summarized that processes, which may become their own determining cause, can give rise to developments which are truly independent of external selection. This can be linked to the notion of *negative freedom from* external determination, but I add that processes in which – in the envisioned multi-level account of evolution – the blindness of variation is reduced might be said to have acquired a certain *positive freedom to* achieve what is necessary. Although this necessity will in biology still be mostly understood as adaptation, particularly in the cultural realm, this general concept of directedness may also become linked to autonomous values or the pursuit of the good, central – for instance to Western philosophy – since Plato.

The brief final Chapter 10 it is sketch how an ethical theory might look like, which would be in coherent with the general results of this work. The regulative idea of the Good in my view should be understood to be a partly autonomous idea with causal relevance, refering to eternal truth discovered or revealed in time. This work does not prove that such an approach is true, but it makes such a view possible. This work builds a much better basis for ethics than universal Darwinism does, since it is open to many quite different conceptions of the Good or God as they are actually found in different schools of ethics or religion.

An Outlook – Towards Ecological Idealism

I should now like to present a slightly speculative more general outlook. There is a streak of W. Wordsworth's blissful dawn to the disputes concerning the interpretation of evolution. A new synthesis seems to be in the making, this time perhaps leaving gene-Darwinism and, perhaps, Darwinism in general behind. This possible evolutionary synthesis will have to draw from Darwinism – even from gene-Darwinism –, but will nevertheless transcend Darwinism and will differ considerably from Darwinism in its philosophical message (likewise, Einstein's theory of relativity did not deny most of the phenomena acknowledged by Newtonian physics). But it appears that more is at stake and that more might be won than a new evolutionary synthesis.

A new philosophical framework, to which this work can of course only be a humble contribution, appears to be needed, neither simply resting on the separation of the two cultures, nor simply unifing them by 'biologising' the social sciences. This framework would differ from universal Darwinism, but still needs to provide a unified ontological account. In post-modern times this might sound implausible also since today's *Lebenswelten* differ enormously, a framework would definitely have to leave much room for plurality. Yet the final decades of the last millenium appear to have been under the spell of universal Darwinism. But spell can be broken. In this work the possibility or even necessity has been pointed out that evolution allows for several new layers of organisation and even evolving evolutionary mechanisms.

The philosophical approach which I personally have in mind might perhaps be called '*ecological idealism*'. This approach does not directly follow from the more sober analysis of this work and should therefore only be characterised shortly.

Idealism refers to the following three aspects of this approach. First, the evolutionary process may broadly be understood as an *intellectual process*. Despite stressing the possibility of enhanced 'sight', the 'blindness' of this process at its very beginning and its remaining short-sightedness is not denied, particularly in biological evolution. Generally, every organism is considered as representing a theory about its environment (and partly about its inner makeup).

Secondly, I have advocated the possiblility of *inherent tendencies* of evolution. In the proposed account, evolution of entities is not just externally governed, but an inner dynamic can, to a certain extent, gain some freedom and detachment. Correspondingly, the 'theories' (organisms and real concepts alike) are not to be understood in the sense of naïve realism. Although entities are 'tested' against the external world, they have an inner structure and an inherent tendency which may, up to a point, sometimes even come to dominate the direction of evolution. (Cf. the treatment of auto-selection and autonomy.) Whether these inner necessities may, at least in culture development may correspond to consistency constrains, known for instance in logic or ethics, is an important question that needs to be addressed in the future.

Thirdly, in respect of culture, it has been advocated that the possibility that values, which may partly serve survival and also partly refer to revealed or discovered ethical truth might become unified by the *regulative idea of the Good*. Human beings not only live to survive but also to realise their ideals. It has been suggested here, that the Good has, in any case, to be understood as taking part in moulding the actual world. However, the outlined understanding is open to be filled in by the different ethical traditions, which either interpret the Good in a relativistic and subjective sense or refer to the necessities of an inner (or outer) logic of forms, understood in an Aristotelian or even Platonic sense. (Cf. the discussion of the notion of the Good; of the evolution of evolutionary processes, and previously advocated hylomorphic conception.) Personally, I favour a view according to which eternal or necessary ethical truth are discovered (or 'revealed') in the process of cultural evolution, but much work is needed to bring together such Platonic, neo-Platonic or Kantian traditions with the idea of evolution.

Despite these three reasons to choose the term 'idealism', it should be made clear that it is not intended to neglect the 'outer' when stressing the importance of the 'inner'. In terms of epistemology I would aim, as has become apparent throught this work, at a combination of coherence theory and correspondence theory of truth. Moreover, a certain inner freedom and an unfolding of inner forms has been advocated, but the freedom from external determiniation is, of course, limited. Hence, it is obviously not intend to defend radical idealism. The term idealism is used only in contrast to other theories which only refer to the external.

The first reason to additionally adopt the adjective '*ecological*' is exactly to moderate this possible understanding of idealism. Ecology usually – from the perspective of a human being – stresses the importance of the outer. Moreover, ecology is often linked with a materialist understanding of nature, although not in a radical downward-reductive sense. These aspects of the notion ecology counterbalance the use of the term idealism. To put it plainly: although we may exist to serve the idea of the Good, we should neither ignore the actual world nor our own limitations in doing what we suppose to do.

Secondly, the term ecological focuses neither on single entities nor on wholes, but rather on their *relations* between elements. The sketched conception of substance puts an emphasis on the concept of relation important to the employed view of nature.

Thirdly, the term 'ecological' suggests that humanity may have developed far enough to take parts of the biotic world into 'the expanding circle' of ethically relevant creatures. This is on the one hand necessary to save the survival of the '*zoon ethicon*', while on the other hand, it is touchstone for whether this animal may deserve this name.

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Index

Although Charles Darwin predicted that his theory “would give zest to [...] metaphysics,” even he would be astonished at the variety of paths his theory has in fact taken. This holds with regard to both gene-Darwinism, a purified Darwinian approach biologizing the social sciences, and process-Darwinism found in the disciplines of psychology, philosophy of science, and economics. Although Darwinism is often linked to highly confirmed biological theories, some of its interpretations seem to profit from tautological claims as well, where scientific reputation cloaks ideological usage. This book discusses central tenets of Darwinism historically as well as systematically, for example the history of different Darwinian paradigms, the units-of-selection debate, and the philosophical problem of induction as basis of metaphysical Darwinism. Crucially the book addresses the Darwinian claim that evolution is governed by an immutable and unrelentingly cruel law of natural selection. Paradoxically, Darwin’s theory is a static, non-evolutionary theory of evolution. The current book sketches the historical background and provides suggestions that may help to replace this approach by the idea of an evolution of evolutionary mechanisms (see Escher’s “Drawing Hands” on the cover). This view even suggests a tendency to overcome the blindness of the knowledge acquisition of primordial Darwinian processes and allows for some freedom from external environments. This book first develops a radically Darwinian approach, then criticises this approach from within. Even Darwinism has a tendency to transcend itself. Although the book addresses several empirical issues, it does not challenge particular findings. Instead it builds on many insights of Darwinism and provides a proposal for interpreting known empirical evidence in a different light. It should help pave the way for further developing an understanding of nature that transcends Darwinian metaphysics.

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GÖTTINGEN

ISBN 978-3-86395-006-4

Universitätsverlag Göttingen