

Expanded Contents

Chapter 1: Defining and Revising the Structure of Evolutionary Theory	1
▪ Theories Need Both Essences and Histories	1
▪ The Structure of Evolutionary Theory: Revising the Three Central Features of Darwinian Logic	12
▪ <i>Apologia Pro Vita Sua</i>	24
A Time to Keep	24
A Personal Odyssey	33
▪ Epitomes for a Long Development	48
Levels of Potential Originality	48
An Abstract of One Long Argument	53

Part I: The History of Darwinian Logic and Debate

Chapter 2: The Essence of Darwinism and the Basis of Modern Orthodoxy: An Exegesis of the <i>Origin of Species</i>	93
▪ A Revolution in the Small	93
▪ Darwin as a Historical Methodologist	97
One Long Argument	97
The Problem of History	99
A Fourfold Continuum of Methods for the Inference of History	103
▪ Darwin as a Philosophical Revolutionary	116
The Causes of Nature's Harmony	116
Darwin and William Paley	116
Darwin and Adam Smith	121
The First Theme: The Organism as the Agent of Selection	125

The Second Theme: Natural Selection as a Creative Force	137
The Requirements for Variation	141
Copious	141
Small	143
Undirected	144
Gradualism	146
The Adaptationist Program	155
The Third Theme: The Uniformitarian Need to Extrapolate: Environment as Enabler of Change	159
▪ Judgments of Importance	163
 Chapter 3: Seeds of Hierarchy	170
▪ Lamarck and the Birth of Modern Evolutionism in Two-Factor Theories	170
The Myths of Lamarck	170
Lamarck as a Source	174
Lamarck's Two-Factor Theory: Sources for the Two Parts	175
The First Set: Environment and Adaptation	176
The Second Set: Progress and Taxonomy	179
Distinctness of the Two Sets	181
Lamarck's Two-Factor Theory: The Hierarchy of Progress and Deviation	175
Antinomies of the Two-Factor Theory	189
▪ An Interlude on Darwin's Reaction	192
▪ No <i>Allmacht</i> without Hierarchy: Weissman on Germinal Selection	197
The <i>Allmacht</i> of Selection	197
Weismann's Argument on Lamarck and the <i>Allmacht</i> of Selection	201
The Problem of Degeneration and Weismann's Impetus for Germinal Selection	203
Some Antecedents to Hierarchy in German Evolutionary Thought	208
Haeckel's Descriptive Hierarchy in Levels of Organization	208
Roux's Theory of Intracorporeal Struggle	210
Germinal Selection as a Helpmate to Personal Selection	214
Germinal Selection as a Full Theory of Hierarchy	219
▪ Hints of Hierarchy in Supraorganismal Selection:	
Darwin on the Principle of Divergence	224
Divergence and the Completion of Darwin's System	224
The Genesis of Divergence	232

Divergence as a Consequence of Natural Selection	234
The Failure of Darwin's Argument and the Need for Species Selection	236
The Calculus of Individual Success	238
The Causes of Trends	240
Species Selection Based on Propensity for Extinction	246
Postscript: Solution to the Problem of the "Delicate Arrangement"	248
▪ Coda	249
 Chapter 4: Internalism and Laws of Form: Pre-Darwinian Alternatives to Functionalism	251
▪ Prologue: Darwin's Fateful Decision	251
▪ Two Ways to Glorify God in Nature	260
William Paley and British Functionalism: Praising God in the Details of Design	262
Louis Agassiz and Continental Formalism: Praising God in the Grandeur of Taxonomic Order	271
An Epilog on the Dichotomy	278
▪ Unity of Plan as the Strongest Version of Formalism: The Pre-Darwinian Debate	281
<i>Mehr Licht</i> on Goethe's Leaf	281
Geoffroy and Cuvier	291
Cuvier and <i>Conditions of Existence</i>	291
Geoffroy's Formalist Vision	298
The Debate of 1830: Foreplay and Aftermath	304
Richard Owen and English Formalism: The Archetype of Vertebrates	312
No Formalism Please, We're British	312
The Vertebrate Archetype: Constraint and Nonadaptation	316
Owen and Darwin	326
▪ Darwin's Strong but Limited Interest in Structural Constraint	330
Darwin's Debt to Both Poles of the Dichotomy	330
Darwin on Correlation of Parts	332
The "Quite Subordinate Position" of Constraint to Selection	339
 Chapter 5: The Fruitful Facets of Galton's Polyhedron: Channels and Saltations in Post-Darwinian Formalism	342
▪ Galton's Polyhedron	342

▪ Orthogenesis as a Theory of Channels and One-Way Streets: the Marginalization of Darwinism	351
Misconceptions and Relative Frequencies	351
Theodor Eimer and the <i>Ohnmacht</i> of Selection	355
Alpheus Hyatt: An Orthogenetic Hard Line from the World of Mollusks	365
C.O. Whitman: An Orthogenetic Dove in Darwin's World of Pigeons	383
▪ Saltation as a Theory of Internal Impetus: A Second Formalist Strategy for Pushing Darwinism to a Causal Periphery	396
William Bateson: The Documentation of Inherent Discontinuity	396
Hugo de Vries: A Most Reluctant Non-Darwinian	415
Dousing the Great Party of 1909	415
The (Not So Contradictory) Sources of the Mutation Theory	418
The Mutation Theory: Origin and Central Tenets	425
Darwinism and the Mutation Theory	439
Confusing Rhetoric and the Personal Factor	439
The Logic of Darwinism and Its Different Place in de Vries' System	443
De Vries on Macroevolution	446
Richard Goldschmidt's Appropriate Role as a Formalist Embodiment of All that Pure Darwinism Must Oppose	451
 Chapter 6: Pattern and Progress on the Geological Stage	467
▪ Darwin and the Fruits of Biotic Competition	467
A Geological License for Progress	467
The Predominance of Biotic Competition and Its Sequelae	470
▪ Uniformity on the Geological Stage	479
Lyell's Victory in Fact and Rhetoric	479
Catastrophism as Good Science: Cuvier's <i>Essay</i>	484
Darwin's Geological Need and Kelvin's Odious Spectre	492
A Question of Time (Too Little Geology)	496
A Question of Direction (Too Much Geology)	497
 Chapter 7: The Modern Synthesis as a Limited Consensus	503
▪ Why Synthesis?	503
▪ Synthesis as Restriction	505
The Initial Goal of Rejecting Old Alternatives	505

R. A. Fisher and the Darwinian Core	508
J. B. S. Haldane and the Initial Pluralism of the Synthesis	514
J. S. Huxley: Pluralism of the Type	516
▪ Synthesis as Hardening	518
The Later Goal of Exalting Selection's Power	518
Increasing Emphasis on Selection and Adaptation between the First (1937) and Last (1951) Edition of Dobzhansky's <i>Genetics</i> and the <i>Origin of Species</i>	524
The Shift in G. G. Simpson's Explanation of "Quantum Evolution" from Drift and Nonadaptation (1944) to the Embodiment of Strict Adaptation (1953)	528
Mayr at the Inception (1942) and Codification (1963): Shifting from the "Genetic Consistency" to the "Adaptationist" Paradigm	531
Why Hardening?	541
▪ Hardening on the Other Two Legs of the Darwinian Tripod	543
Levels of Selection	544
Extrapolation into Geological Time	556
▪ From Overstressed Doubt to Overextended Certainty	566
A Tale of Two Centennials	566
All Quiet on the Textbook Front	576
Adaptation and Natural Selection	577
Reduction and Trivialization of Macroevolution	579
 Segue to Part II	585

**Part II: Towards a Revised and Expanded
Evolutionary Theory**

Chapter 8: Species as Individuals in the Hierarchical Theory of Selection	595
▪ The Evolutionary Definition of Individuality	595
An Individualistic Prolegomenon	595
The Meaning of Individuality and the Expansion of the Darwinian Research Program	597
Criteria for Vernacular Individuality	602
Criteria for Evolutionary Individuality	608
▪ The Evolutionary Definition of Selective Agency and the Fallacy of Selfish Genes	613

A Fruitful Error of Logic	613
Hierarchical <i>vs.</i> Genic Selectionism	614
The Distinction of Replicators and Interactors as a Framework for Discussion	615
Faithful Replication as the Central Criterion for the Gene-Centered View of Evolution	616
Sieves, Plurifiers, and the Nature of Selection: The Rejection of Replication as a Criterion of Agency	619
Interaction as the Proper Criterion for Identifying Units of Selection	622
The Internal Incoherence of Gene Selectionism	625
Bookkeeping and Causality: The Fundamental Error of Gene Selectionism	632
Gambits of Reform and Retreat by Gene Selectionists	637
▪ Logical and Empirical Foundations for the Theory of Hierarchical Selection	644
Logical Validation and Empirical Challenges	644
R. A. Fisher and the Compelling Logic of Species Selection	644
The Classical Arguments against Efficacy of Higher-Level Selection	646
Overcoming These Classical Arguments, in Practice for Interdemic Selection, but in Principle for Species Selection	648
Emergence and the Proper Criterion for Species Selection	652
Differential Proliferation or Downward Effect?	652
Shall Emergent Characters or Emergent Fitnesses Define the Operation of Species Selection?	656
Hierarchy and the Sixfold Way	673
A Literary Prologue for the Two Major Properties of Hierarchies	673
Redressing the Tyranny of the Organism: Comments on Characteristic Features and Differences among Six Primary Levels	681
The Gene-Individual	683
Motoo Kimura and the "Neutral Theory of Molecular Evolution"	684
True Genic Selection	689
The Cell-Individual	695
The Organism-Individual	700
The Deme-Individual	701
The Species-Individual	703

Species as Individuals	703
Species as Interactors	704
Species Selection as Potent	709
The Clade-Individual	712
▪ The Grand Analogy: A Speciation Basis for Macroevolution	714
Presentation of the Chart for Macroevolutionary Distinctiveness	714
The Particulars of Macroevolutionary Explanation	716
The Structural Basis	716
Criteria for Individuality	720
Contrasting Modalities of Change: The Basic Categories	721
Ontogenetic Drive: The Analogy of Lamarckism and Anagenesis	722
Reproductive Drive: Directional Speciation as an Important and Irreducible Macroevolutionary Mode Separate from Species Selection	724
Species Selection, Wright's Rule, and the Power of Interaction with Directional Speciation	731
Species Level Drifts as More Powerful than the Analogous Phenomena in Microevolution	735
The Scaling of External and Internal Environments	738
Summary Comments on the Strengths of Species Selection and its Interaction with Other Macroevolutionary Causes of Change	741
Chapter 9: Punctuated Equilibrium and the Validation of Macroevolutionary Theory	745
▪ What Every Paleontologist Knows	745
An Introductory Example	745
Testimonials to Common Knowledge	749
Darwinian Solutions and Paradoxes	755
The Paradox of Insulation from Disproof	758
The Paradox of Stymied Practice	761
▪ The Primary Claims of Punctuated Equilibrium	765
Data and Definitions	765
Microevolutionary Links	774
Macroevolutionary Implications	781
Tempo and the Significance of Stasis	782
Mode and the Speciation Foundation of Macroevolution	783

▪ The Scientific Debate on Punctuated Equilibrium: Critiques and Responses	784
Critiques Based on the Definability of Paleontological Species	784
Empirical Affirmation	784
Reasons for a Potential Systematic Underestimation of Biospecies by Paleospecies	789
Reasons for a Potential Systematic Overestimation of Biospecies by Paleospecies	792
Reasons Why an Observed Punctuational Pattern Might Not Represent Speciation	793
Critiques Based on Denying Events of Speciation as the Primary Locus of Change	796
Critiques Based on Supposed Failures of Empirical Results to Affirm Predictions of Punctuated Equilibrium	802
Claims for Empirical Refutation by Cases	802
Phenotypes	802
Genotypes	810
Empirical Tests of Conformity with Models	812
▪ Sources of Data for Testing Punctuated Equilibrium	822
Preamble	822
The Equilibrium in Punctuated Equilibrium: Quantitatively Documented Patterns of Stasis in Unbranched Segments of Lineages	824
The Punctuations of Punctuated Equilibrium: Tempo and Mode in the Origin of Paleospecies	839
The Inference of Cladogenesis by the Criterion of Ancestral Survival	840
The "Dissection" of Punctuations to Infer Both Existence and Modality	850
Time	851
Geography	852
Morphometric Mode	852
Proper and Adequate Tests of Relative Frequencies: The Strong Empirical Validation of Punctuated Equilibrium	854
The Indispensability of Data on Relative Frequencies	854
Relative Frequencies for Higher Taxa in Entire Biotas	856
Relative Frequencies for Entire Clades	866
Causal Clues from Differential Patterns of Relative Frequencies	870

▪ The Broader Implications of Punctuated Equilibrium for Evolutionary Theory and General Notions of Change	874
What Changes May Punctuated Equilibrium Instigate in Our Views about Evolutionary Mechanisms and the History of Life?	874
The Explanation and Broader Meaning of Stasis	874
Frequency	875
Generality	876
Causality	877
Punctuation, the Origin of New Macroevolutionary Individuals, and Resulting Implications for Evolutionary Theory	885
Trends	886
The Speciation Reformulation of Macroevolution	893
Life Itself	897
General Rules	901
Particular Cases	905
Horses as the Exemplar of "Life's Little Joke"	905
Rethinking Human Evolution	908
Ecological and Higher-Level Extensions	916
Punctuation All the Way Up and Down? The Generalization and Broader Utility of Punctuated Equilibrium (in More Than a Metaphorical Sense) at Other Levels of Evolution, and for Other Disciplines In and Outside the Natural Sciences	922
General Models for Punctuated Equilibrium	922
Punctuational Change at Other Levels and Scales of Evolution	928
A Preliminary Note on Homology and Analogy in the Conceptual Realm	928
Punctuation Below the Species Level	931
Punctuation Above the Species Level	936
Stasis Analogs: Trending and Non-Trending in the Geological History of Clades	936
Punctuational Analogs in Lineages: The Pace of Morphological Innovation	939
Punctuational Analogs in Faunas and Ecosystems	946
Punctuational Models in Other Disciplines: Towards a General Theory of Change	952
Principles for a Choice of Examples	952
Examples from the History of Human Artifacts and Cultures	952
Examples from Human Institutions and Theories about the Natural World	957

Two Concluding Examples, a General Statement, and a Coda	962
▪ Appendix: A Largely Sociological (and Fully Partisan) History of the Impact and Critique of Punctuated Equilibrium	972
The Entrance of Punctuated Equilibrium into Common Language and General Culture	972
An Episodic History of Punctuated Equilibrium	979
Early Stages and Future Contexts	979
Creationist Misappropriation of Punctuated Equilibrium	986
Punctuated Equilibrium in Journalism and Textbooks	990
The Personal Aspect of Professional Reaction	999
The Case <i>Ad Hominem</i> against Punctuated Equilibrium	1000
An Interlude on Sources of Error	1010
The Wages of Jealousy	1014
The Descent to Nastiness	1014
The Most Unkindest Cut of All	1019
The Wisdom of Agassiz's and von Baer's Threefold History of Scientific Ideas	1021
A Coda on the Kindness and Generosity of Most Colleagues	1022
 Chapter 10: The Integration of Constraint and Adaptation (Structure and Function) in Ontogeny and Phylogeny: Historical Constraints and the Evolution of Development	1025
▪ Constraint as a Positive Concept	1025
Two Kinds of Positivity	1025
An Etymological Introduction	1025
The First (Empirical) Positive Meaning of Channeling	1027
The Second (Definitional) Positive Meaning of Causes outside Accepted Mechanisms	1032
Heterochrony and Allometry as the <i>Locus Classicus</i> of the First Positive (Empirical) Meaning. Channeled Directionality by Constraint.	1037
The Two Structural Themes of Internally Set Channels and Ease of Transformation as Potentially Synergistic with Functional Causality by Natural Selection: Increasing Shell Stability in the <i>Gryphaea</i> Heterochronocline	1040
Ontogenetically Channeled Allometric Constraint as a Primary Basis of Expressed Evolutionary Variation: The Full Geographic and Morphological Range of <i>Cerion uva</i>	1045

The Aptive Triangle and the Second Positive Meaning: Constraint as a Theory-Bound Term for Patterns and Directions Not Built Exclusively (Or Sometimes Even at All) by Natural Selection	1051
The Model of the Aptive Triangle	1051
Distinguishing and Sharpening the Two Great Questions	1053
The Structural Vertex	1053
The Historical Vertex	1055
An Epitome for the Theory-Bound Nature of Constraint Terminology	1057
▪ Deep Homology and Pervasive Parallelism: Historical Constraint as the Primary Gatekeeper and Guardian of Morphospace	1061
A Historical and Conceptual Analysis of the Underappreciated Importance of Parallelism for Evolutionary Theory	1061
A Context for Excitement	1061
A Terminological Excursus on the Meaning of Parallelism	1069
The Nine Fateful Little Words of E. Ray Lankester	1069
The Terminological Origin and Debate about the Meaning and Utility of Parallelism	1076
A Symphony in Four Movements on the Role of Historical Constraint in Evolution: Towards the Harmonious Rebalancing of Form and Function in Evolutionary Theory	1089
Movement One, Statement: Deep Homology across Phyla: Mayr's Functional Certainty and Geoffroy's Structural Vindication	1089
Deep Homology, Archetypal Theories, and Historical Constraint	1089
<i>Mehr Licht</i> (More Light) on Goethe's Angiosperm Archetype	1092
Hoxology and Geoffroy's First Archetypal Theory of Segmental Homology	1095
An Epitome and Capsule History of Hoxology	1095
Vertebrate Homologs in Structure and Action	1101
Segmental Homologies of Arthropods and Vertebrates: Geoffroy's Vindication	1106
Rediscovering the Vertebrate Rhombomeres	1107
More Extensive Homologies throughout the Developing Somites	1109
Some Caveats and Tentative Conclusions	1112
Geoffrey's Second Archetypal Theory of Dorso-Ventral Inversion in the Common Bilaterian Groundplan	1117

Movement Two, Elaboration: Parallelism of Underlying Generators: Deep Homology Builds Positive Channels of Constraint	1122
Parallelism All the Way Down: Shining a Light and Feeding the Walk	1122
Parallelism in the Large: <i>Pax-6</i> and the Homology of Developmental Pathways in Homoplastic Eyes of Several Phyla	1123
Data and Discovery	1123
Theoretical Issues	1127
A Question of Priority	1130
Parallelism in the Small: The Origin of Crustacean Feeding Organs	1132
Pharaonic Bricks and Corinthian Columns	1134
Movement Three, Scherzo: Does Evolutionary Change Often Proceed by Saltation Down Channels of Historical Constraint?	1142
Movement Four, Recapitulation and Summary: Early Establishment of Rules and the Inhomogenous Population of Morphospace: Dobzhansky's Landscape as Primarily Structural and Historical, Not Functional and Immediate	1147
Bilaterian History as Top-Down by Tinkering of an Initial Set of Rules, Not Bottom-Up by Adding Increments of Complexity	1147
Setting of Historical Constraints in the Cambrian Explosion	1155
Channeling the Subsequent Directions of Bilaterian History from the Inside	1161
An Epilog on Dobzhansky's Landscape and the Dominant Role of Historical Constraint in the Clumped Population of Morphospace	1173
Chapter 11: The Integration of Constraint and Adaptation (Structure and Function) in Ontogeny and Phylogeny: Structural Constraints, Spandrels, and the Centrality of Exaptation in Macroevolution	1179
▪ The Timeless Physics of Evolved Function	1179
Structuralism's Odd Man Outside	1179
D'Arcy Thompson's Science of Form	1182
The Structure of an Argument	1182
The Tactic and Application of an Argument	1189
The Admitted Limitation and Ultimate Failure of an Argument	1196

Odd Man In (D'Arcy Thompson's Structuralist Critique of Darwinism) and Odd Man Out (His Disparagement of Historicism)	1200
An Epilog to an Argument	1207
Order for Free and Realms of Relevance for Thompsonian Structuralism	1208
▪ Exapting the Rich and Inevitable Spandrels of History	1214
Nietzsche's Most Important Proposition of Historical Method	1214
Exaptation and the Principle of Quirky Functional Shift: The Restricted Darwinian Version as the Ground of Contingency	1218
How Darwin Resolved Mivart's Challenge of Incipient Stages	1218
The Two Great Historical and Structural Implications of Quirky Functional Shift	1224
How Exaptation Completes and Rationalizes the Terminology of Evolutionary Change by Functional Shifting	1229
Key Criteria and Examples of Exaptation	1234
The Complete Version, Replete with Spandrels: Exaptation and the Terminology of Nonadaptive Origin	1246
The More Radical Category of Exapted Features with Truly Nonadaptive Origins as Structural Constraints	1246
Defining and Defending Spandrels: A Revisit to San Marco	1249
Three Major Reasons for the Centrality of Spandrels, and Therefore of Nonadaptation, in Evolutionary Theory	1258
▪ The Exaptive Pool: The Proper Conceptual Formula and Ground of Evolvability	1270
Resolving the Paradox of Evolvability and Defining the Exaptive Pool	1270
The Taxonomy of the Exaptive Pool	1277
Franklins and Miltons, or Inherent Potentials vs. Available Things	1277
Choosing a <i>Fundamentum Divisionis</i> for a Taxonomy: An Apparently Arcane and Linguistic Matter That Actually Embodies a Central Scientific Decision	1280
Cross-Level Effects as Miltonic Spandrels, Not Franklinian Potentials: The Nub of Integration and Radical Importance	1286
A Closing Comment to Resolve the Macroevolutionary Paradox that Constraint Ensures Flexibility Whereas Selection Crafts Restriction	1294

Chapter 12: Tiers of Time and Trials of Extrapolationism, With an Epilog on the Interaction of General Theory and Contingent History	1296
▪ Failure of Extrapolationism in the Non-Isotropy of Time and Geology	1296
The Specter of Catastrophic Mass Extinction: Darwin to Chicxulub	1296
The Paradox of the First Tier: Towards a General Theory of Tiers of Time	1320
▪ An Epilog on Theory and History in Creating the Grandeur of This View of Life	1332

THE STRUCTURE OF EVOLUTIONARY THEORY
