A Synthetic History of Biology

The Growth of Biological Thought. Diversity, Evolution, and Inheritance. ERNST MAYR. Harvard University Press, Cambridge, Mass., 1982. xiv, 974 pp., illus. $30.

One cannot help standing in awe of the Germanic capacity for vast, all-embracing synthesis: consider the lifelong devotion of Goethe to *Faust*, or Wagner's integration of the arts into a *Gesamtkunstwerk* in which all of human history and experience is wrought into epic myth. It is perhaps in this tradition that Ernst Mayr's *The Growth of Biological Thought* stands: a history of all of biology, a *Ring des Nibelungen* complete with leitmotivs such as the failures of reductionism, the struggle of biology for independence from physics, and the liberation of populational thinking from the bonds of essentialism. Mayr's goal is to draw from the successful and unsuccessful ideas of the past an integrated history of all of biology and its implications for the philosophy of science.

The Growth of Biological Thought is no mere chronicle of important theories and experiments. It is rather, as the title implies, an analysis of the history of ideas in the tradition of Lovejoy's *The Great Chain of Being*, an attempt to analyze the forces that aided or frustrated the development of the great insights of biological science: the impact of philosophical and theological traditions, of the nonbiological sciences, of appropriate and inappropriate experimental materials, of social and political currents, of communication and its absence among disciplines, of forceful and weaker personalities on the progress of each major area of biology. Mayr believes that evolutionary biology (*sensu lato*), the study of ultimate causation, and functional biology, the study of proximate causation, are methodologically and ideologically largely self-contained; thus this volume treats the history of systematics, evolutionary theory, heredity, and some ancillary areas (for example, biogeography, cytology), and the history of physiology and other functional disciplines are deferred to a future volume.

One of the most influential evolutionary biologists of the century, Mayr brings to this history a depth of understanding of biology that a historian would be hard put to match. But the authority with which he speaks brings with it points of view that future historians will have to examine carefully. He writes as a biologist, not as a professional historian or philosopher of science, and this must almost certainly color his analysis. Thus, for example, he finds rather little influence of sociopolitical events and *Zeitgeister* on the genesis and development of biological concepts and goes to great lengths to demonstrate that biology not only is autonomous from the physical sciences but is if anything hampered by the conceptual methodology of physics and chemistry. And because he has been instrumental in the development and promulgation of certain important ideas in evolutionary and systematic biology, it is not surprising to find in his very assertive treatment of the history of classification, species concepts, the origin of evolutionary novelties, and many other topics the stamp of one concerned to reaffirm the validity of ideas that he himself helped bring into life. His writing shows the impress of his background in natural history, of a tendency to antireductionism that he himself acknowledges readily, and of a distrust of, and even hostility toward, mathematical theory. "I have sometimes been called dogmatic," he remarks, but says that his attitude is not dogmatism but a tendency to make sweeping categorical statements because of his belief in the value of Hegelian dialectic. The reader will be advised to heed the warning, especially in passages where Mayr treats current ideas in evolution and systematics without discussing at much length ideas at variance with his own.

Mayr does not present a single historical chronicle of biology but traces each important concept from its beginnings forward. He frames the history by introductory and concluding reflections on the conceptual structure of biology, its overall development, its place in the sciences, the factors that account for the successful maturation of scientific ideas. He argues, I think quite successfully, that, though the discovery of new facts is sometimes critical to scientific advance, progress in biology depends more on the integration and reinterpretation of facts, on the elimination of semantic confusion, invalid concepts, and erroneous theories, and on the synthesis of independently developing fields of inquiry.

There are at least a few errors, some of which are undoubtedly accidental (for example, the statement that the classical techniques of *Drosophila* genetics can make only one locus at a time homozygous, when the problem is that the very opposite is true); more important, however, almost every biologist will disagree with some of Mayr's interpretations. One could well question whether the physical sciences (such as cosmology) have fewer ethical or moral implications than biology—witness the current creationist attack not only on evolution but on the physical sciences as well. In his treatment of systematics, Mayr is surprisingly complimentary to cladistic methods of phylogenetic inference (although not to the cladists' philosophy of classification), but both cladists and pheneticists will bristle at his rather predictable treatment of their views. To my surprise, Mayr offers a new definition of biological species that incorporates both reproductive isolation and ecological differentiation, but his thorough acceptance of the competitive exclusion principle is one that many ecologists will not share. Similarly, Mayr is considerably more certain than are many population geneticists that protein variation is governed by natural selection. Incidentally, geneticists such as Crow and Kimura will be surprised to read that "Marxists, on the whole, attribute a greater role to random-walk evolution than non-Marxists." As might be expected Mayr devotes many pages to defending ideas that figured prominently in his earlier publications, such as the ubiquity of selection, coadaptation of gene pools, and speciation by genetic revolution in small populations, but the reader should be aware that a considerable amount of current theoretical and empirical research in population genetics challenges these views.

It is a measure of Mayr's influence on evolutionary biology that his views on these and other topics have stimulated so much research, argument, and criticism. *The Growth of Biological Thought* will surely have the same impact on the history of biology, for innumerable points invite argument. Can we agree with Mayr that the idea of social progress did not pave the way for the idea of evolution? That Chambers and Spencer are unimportant figures in the history of evolutionary thought? That von Baer's laws were not widely adopted because they were descriptive and sterile whereas Haeckel's recapitulation theory was "wonderfully heuristic"? That population genetics failed to address macroevolutionary phenomena because it did not take a holistic view of the integrated genotype? It is refreshing to see Mayr admit that Sewall Wright recognized the importance of gene interactions and influenced Simpson's development of the idea of quantum evolution; but can we agree that Wright "made little use of this insight in his equations and graphs"? Here and elsewhere one feels that Mayr has been a victim of that same lamentable rift between mathematical theoreticians and naturalists that delayed the arrival of the Modern Synthesis, and that persists still.

Mayr's larger theses, which I believe are on the whole well defended, are important enough to bear examination. Mayr feels strongly that the physical sciences have had an unwarranted influence on the philosophy of science and the prevailing ideas of what constitutes acceptable scientific method; he is vehement in his assertion that attempts to apply in biology the reductionism, elementary mechanistic ideas, and mathematical formulation of general laws that serve physics so well have hindered the development of sound biological concepts. Mathematical theory is useful in physics, but in sciences such as systematics and much of evolutionary biology "the contributions of mathematics are very minor" and often misleading. Biological systems are so complex and so integrated that reductionism is as often a hindrance to progress in biology as it is (as in the case of Mendel) an advantage. Mayr's antireductionism is especially evident in his treatment of population genetics, which, by defining evolution as changes in gene frequencies, cannot explain, he says, the evolution of complex adaptations and the origin of diversity.

Perhaps the major thesis of Mayr's book, and the most important one, is that biology can expand the philosophy of science beyond the limits defined by the physical sciences. Not only are biological systems too complex to admit of simple reductionism; they are too diverse to admit of universal laws and can be described only by "probabilistic" generalizations to which there invariably will be exceptions. Mayr's book is a deeply felt celebration of diversity: the diversity of life that makes biological "laws," or regularities, so different from physical laws; the study of diversity that led naturalists to make so many more contributions to biology than are often recognized (this is, indeed, a major theme); the recognition of diversity with-

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in populations that is, according to Mayr, the source of almost every insight that has led to progress in the biology of ultimate causation. No theme is more insistently sounded than the crucial role of "populational thinking," the recognition of individual differences. No obstacle to progress in biology has been as great as essentialism, "the most insidious of all philosophies." Platonic idealism may serve for physics, but Plato was a disaster for biology, and "the rise of modern biological thought is, in part, the emancipation from Platonic thinking." Mayr's development of this theme alone, even if overstated in places, is a major contribution.

It is, of course, easy to find debatable points in any work of this magnitude, especially when it is penned by so forceful a personality. But it would take a far longer review than this to describe the book's virtues. It is a work of immense scholarship; it treats virtually every historical figure and idea that has had an impact, for good or ill, on the subjects discussed; it is above all a work of interpretation, of reflection on the larger significance of every substantial ripple in the current of biological history. Interesting facts and interpretations abound: how natural theology benefited evolutionary theory by asking questions about adaptations; how Lyell's uniformitarianism prevented him from recognizing evolution; how *Naturphilosophie* developed in reaction to reductionism; how Franz Unger's concern with the nature of species may have led his student Mendel to his work; how Darwin could find inspiration by applying Malthusianism to individuals rather than to species; how Lyell's and Weissmann's views influenced the development of evolutionary theory by their sheer forcefulness; how induction failed, and deduction succeeded, in developing a theory of genetics; how Galton arrived at a particulate theory of inheritance but failed to promulgate it in the right journals. Mayr has provided far more than a compilation of historical events; he treats history in the best tradition of evolutionary biology, offering on almost every page new interpretations and reasoned speculations to account for the origin, diversification, and extinction of ideas.

To wish for greater coverage of some topics would be ungracious, but some few questions are not developed to the fullest. How, for example, did the theory of polygenic inheritance develop and find acceptance? Why were Lamarck's ideas not accepted? What role did geology and anthropology play in the origin of evolutionary thinking? In other instances Mayr carefully identifies questions that he leaves for future historians. For example, he discusses at some length the contributions of evolutionary natural history and systematics to evolutionary thought and notes that a detailed history of this topic is yet to be written. But it is hard to think of anything that has escaped Mayr's notice. The number of questions raised and provisionally answered is breathtaking, the amount of historical detail is overwhelming, and the challenges to future historians are innumerable.

The publisher has performed an extraordinary service by making the book available at such a reasonable price. It can, and should, find a place in the personal library of every student and professional worker in biology or the history of science. This is an extraordinary, epic, work in which Mayr once again shows himself a master of detail, interpretation, and synthesis.

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The Work of Dobzhansky

Dobzhansky's Genetics of Natural Populations, I–XLIII. R. C. LEWONTIN, JOHN A. MOORE, WILLIAM B. PROVINE, and BRUCE WALLACE, Eds. Columbia University Press, New York, 1981. xiv, 942 pp., illus., + plates. $42.50.

The Roving Naturalist. Travel Letters of Theodosius Dobzhansky. BENTLEY GLASS, Ed. American Philosophical Society, Philadelphia, 1980. x, 328 pp. Paper, $8. Memoirs of the American Philosophical Society, vol. 139.

Theodosius Dobzhansky is regarded by many as the most influential figure participating in the "neo-Darwinian synthesis" that occurred during the late 1930's. Dobzhansky's book *Genetics and the Origin of Species*, published in 1937, was his main contribution to the synthesis. In it he brought together the then recent theoretical results of Sewall Wright, J. B. S. Haldane, and R. A. Fisher with his own observations on the genetic structure of natural populations and the speciation process. The book must be ranked as one of the great contributions to 20th-century science.

In 1938 Dobzhansky published the first paper in his Genetics of Natural Populations (GNP) series. He continued to contribute to this series until his death in 1975. Since the granting of membership of a particular paper to the series appears to be more or less random, the series may be viewed as a representative cross-section of his work and a natural target for inclusion in a book of the "collected works" genre. This particular collection, however, is considerably more than the juxtapositing of a number of influential papers. It includes a discussion of the origins of the GNP series by William Provine, an essay by R. C. Lewontin that evaluates the scientific contribution of the series, a prelude to each of the papers that places the paper in its historical context and comments on problems that have been identified since the paper's publication, and a series of photographs of the collecting localities that Dobzhansky frequented and of his numerous students and coworkers.

Provine's essay on the origins of the GNP series examines the early work of Dobzhansky, particularly his collaborations with Sturtevant and Wright. It is clear that both of these men had an enormous influence on the direction of Dobzhansky's research and, in Sturtevant's case, on his education as well. In fact, Dobzhansky viewed himself as Sturtevant's student even though he had completed his degree-gathering while still in Russia. Sturtevant's influence can be measured in the draft of a grant proposal "Status and Prospects of the *Drosophila pseudoobscura* Analysis" that Sturtevant wrote and sent to Wright in 1936. In it can be found the outline of much of the GNP series. The planned collaboration of Dobzhansky and Sturtevant on this proposal broke down because of the much-discussed falling out between them. Provine suggests several reasons for the squabble. The one I find most consistent with the personalities involved stems from Sturtevant's disenchantment with the quality of Dobzhansky's cytological work. Sturtevant was a meticulous scientist who one imagines would be very intolerant of the errors that repeatedly crept into Dobzhansky's often hastily done cytology.

With Sturtevant out of the picture Dobzhansky turned to Wright for assistance with the quantitative aspects of his