

Introduction

Like Charles Darwin during the 19th century, Ernst Mayr worked indefatigably for a better understanding of the central importance of organic evolution, and he fought for the recognition of the independence and autonomy of biology among the natural sciences. His research career comprised several branches of biology and spanned 80 years. His extraordinary scientific contributions total over 750 articles and 21 books (plus about 120 book reviews). His books, and many of his articles, manifest a rare ability to critically synthesize the knowledge gained in distant fields of research. In the sense of emergence, these synthetic works are more than the sum of their parts integrating successively (a) systematics and genetics, (b) evolutionary biology and (c) the history and philosophy of biology.

Above all, Ernst Mayr was a naturalist who endeavored to comprehend the living world in all its relations with respect to diversity, populations, and evolution. He watched birds since his youth in Germany and continued this activity later in North America. He was interested in the behavior of birds, their diverse ecological relations as well as their environments, and he included in his studies other groups of animals as well, like Charles Darwin and Alfred Russel Wallace had done a hundred years earlier.

Ornithology, systematics and zoogeography—Mayr's first synthesis. I distinguish three periods of Mayr's career which, of course, were broadly transitional. The first, as an ornithologist, systematist, and zoogeographer, encompassed his work as an assistant curator at the Museum of Natural History in Berlin (1926–1930) and as curator of ornithology at the American Museum of Natural History in New York (1931–1953). This transition, his familiarity with European and North American ornithological research, was decisively important. Dr. Erwin Stresemann (1889–1972) was his teacher in Berlin and conveyed the knowledge of modern ornithology (“New Avian Biology”) and systematics to Mayr (see Stresemann 1927–1934) and had arranged for expeditions to New Guinea and the Solomon Islands (1928–1930). The results gained during these expeditions were the foundation of Mayr's later systematic studies at the museum in New York where he analyzed the variation, distribution patterns, and speciation of the birds of Oceania, especially of New Guinea, Melanesia, and Polynesia. He also established the basic tenets of island biogeography and forged a synthesis of systematics, natural history, genetics and evolution with the publication of his book, *Systematics and the Origin of Species from the Viewpoint of a Zoologist* (1942e), which became one of the founding documents of the new synthetic theory of evolution and explained a whole set of phenomena well known to systematists and naturalists but not to the geneticists such as species

and speciation, the effects of natural selection on natural populations, the nature of geographical variation, and the role of species in macroevolution. Mayr influenced ornithology by encouraging amateurs in the New York region to undertake biological studies of local birds, by publishing M. M. Nice's pioneering population study of the Song Sparrow, by establishing bird family relations when cataloging and arranging the Rothschild Collection as well as by editing the continuation of J. L. Peters' *Check-list of Birds of the World*. Mayr's work as an ornithologist formed the foundation of his studies as an evolutionist.

Evolutionary biology—Mayr's second synthesis. The second period of Mayr's career as an Alexander Agassiz Professor of Zoology, Harvard University (Cambridge, Massachusetts), beginning in 1953, witnessed the development of modern evolutionary biology. Some topics of his studies were the emergence of evolutionary novelties, the nature of isolating mechanisms, the biological species concept, the significance of ecological-geographical separation of populations, and the dual nature of evolution: "vertical" phyletic evolution (adaptive change through time) and "horizontal" evolution in geographical space (speciation, origin of diversity). The climax of this work was the publication of his books, *Animal Species and Evolution* (1963b) and *Populations, Species, and Evolution* (1970e), masterly summations of species and speciation, and magnificent syntheses of population genetics, variation of populations, the origin of species, and adaptive specialization.

History and philosophy of biology—Mayr's third synthesis. The third period of Mayr's career was devoted to the history and philosophy of biology with new considerations on the basis of systematics and evolutionary biology. It began during the late 1950s but mainly followed his "retirement" as director of the Museum of Comparative Zoology at Harvard University in 1970 and as a university professor in 1975. He discovered in the history of science an evolution of certain themes, concepts, problems, and ideas similar to that of organisms. He wrote on Darwin and his time (the "First Darwinian Revolution") and on the development of the Synthetic Theory of Evolution during the 1940s (the "Second Darwinian Revolution"). The core of the history of science is the evolution of ideas and concepts. Mayr used the theories of natural selection and population thinking as theoretical models within the framework of historical biological studies. He suggested that various competing paradigms may exist side by side and more or less pronounced "revolutions" may occur in different fields from time to time. Changes of concepts have a much stronger effect on the development of biological sciences than the discovery of new facts. Mayr was the first to emphasize the role of biopopulations, thereby pointing out the basic difference between "population thinking" and typological essentialism. Population thinking takes into consideration the uniqueness of each individual and unlimited variation of populations that may lead to the development of new species. On the other hand, typologists assume that the unchanging essence of each species determines variation and fixed limits of variation preclude speciation from occurring except through saltation. The genetic program of organisms is the result of selection, which acted upon millions of generations and therefore is a causal factor that differs fundamentally from physico-chemical

causes. He emphasized the significance of immediate (direct, proximate) causes and ultimate causes in biology. Functional biology deals with direct, proximate causes, which concern the phenotype and poses “How?” questions, whereas evolutionary biology investigates the history of the genotype of organisms and poses “Why?” questions. In his recent books, Ernst Mayr united systematics, evolutionary biology, and the history of biology with the theoretical and philosophical foundations of the biological sciences. The titles of these books are *The Growth of Biological Thought* (1982d), *Toward a New Philosophy of Biology. Observations of an Evolutionist* (1988e), *This is Biology. The Science of the Living World* (1997b), *What Evolution Is* (2001f), and *What Makes Biology Unique? Considerations on the Autonomy of a Scientific Discipline* (2004a). Mayr decisively influenced the fields of systematics, evolutionary biology, and history of biology and he worked toward the foundation of a modern philosophy of biology. In this process, he developed a new vision of modern biology as the *Leitwissenschaft*, the guiding science, of the 21st century, when functional and evolutionary biology jointly contribute to further progress.

“When it comes to philosophical questions that specifically relate to man, his well-being and his future, it is the science of biology that will be most suitable as starting point for all analysis, rather than the physical sciences” (1969g: 202). “Overpopulation, the destruction of the environment, and the malaise of the inner cities cannot be solved by technological advances, nor by literature or history, but ultimately only by measures that are based on an understanding of the biological roots of these problems” (1997b: XV).

Historical chance events. In both publications and oral presentations, Ernst Mayr repeatedly emphasized the historicity of the course of life of most people and that much of what we find in the world around us has come about in consequence of historical accidents, not natural inevitabilities. Chance and coincidence played an especially important role in his life “just as in Darwinian evolution” determining the course of his unfolding career during the 1920s and 1930s (Bock 1994a; 2004c). In this metaphor, “necessity” through natural selection, the second factor of Darwinian evolution, is the manner in which Mayr utilized these chance events each of which gave a new turn to the course of his life and career. Most important was that in each of these new turning points, it was up to him and his hard work and dedication in which way he made the best of the new opportunities that these chance events opened up for him. These events will be mentioned in the context of his developing career in the following chapters, but are summarized here in view of their biographical significance:

- (1) The observation of a pair of rare ducks near his hometown of Dresden (Germany) in March 1923 led to his first contact with Dr. Erwin Stresemann in Berlin, the leading ornithologist in the country, who later persuaded Mayr to become a biologist instead of a medical doctor (pp. 22, 32).
- (2) Plans for ornithological expeditions to Peru and Cameroon in 1926 and 1927 did not materialize; instead Mayr went on an expedition to New Guinea

- (1928–1929) to replace Lord Walter Rothschild’s collector in that region who had a stroke and had to return Europe (p. 49).
- (3) When Mayr was about to return to Germany from New Guinea in the spring of 1929, the leader of the Whitney South Sea Expedition (WSSE) of the American Museum of Natural History in New York (AMNH), Rollo H. Beck, retired after 8 long years of service and the expedition badly needed the assistance of an ornithological expert and therefore Mayr joined the expedition to the Solomon Islands (July 1929 to February 1930); pp. 74–75.
 - (4) The ornithologist Ernst Hartert, director of W. Rothschild’s private museum in Tring, near London, retired in early 1930 and W. Rothschild planned to have Mayr as his successor (p. 96, footnote). However, at that time, Rothschild was in financial difficulties and within 2 years had to sell almost all of his bird collections to the AMNH.
 - (5) At this same time, an expert especially on the avifaunas of the southwest Pacific and New Guinea was needed in New York, and Mayr had already attracted Dr. Sanford’s attention, a trustee of the AMNH, who arranged (on Dr. Stresemann’s recommendation) for him to work in New York on the material of the WSSE during temporary assignments in 1931 and 1932 (p. 96).
 - (6) The transfer of Rothschild’s collection to New York at the “right time” led to Mayr’s employment as curator of the Whitney-Rothschild collections at the AMNH (p. 98).
 - (7) At a symposium on speciation in December 1939, Mayr gave a splendid lecture, his first theoretical paper, by observing and learning from his preceding speaker what not to do. Mayr’s clear presentation led to his invitation by Professor L. C. Dunn to give (with E. Anderson) the famous Jesup Lectures at Columbia University, New York, in March 1941 (p. 190).
 - (8) The shift of the research interests of his botanical colleague E. Anderson after their joint lectures induced Mayr to enlarge his contribution and to prepare his seminal book, *Systematics and the Origin of Species* (1942e), pp. 193–194.
 - (9) When the “Committee on Common Problems of Genetics and Paleontology” was founded in early 1943, the head of the Eastern Group’s genetics section, Th. Dobzhansky, left for Brazil for 1 year and Mayr was placed in charge. From this position, developed his leadership in evolutionary studies in the United States during the late 1940s and 1950s (p. 234).