1991

Foreword

Scott F. Gilbert  
Swarthmore College, sgilber1@swarthmore.edu

Follow this and additional works at: https://works.swarthmore.edu/fac-biology

Part of the Biology Commons
Let us know how access to these works benefits you

Recommended Citation
https://works.swarthmore.edu/fac-biology/354

This work is brought to you for free and open access by . It has been accepted for inclusion in Biology Faculty Works by an authorized administrator of Works. For more information, please contact myworks@swarthmore.edu.
Foreword

Thank goodness someone has written a new biography of Elie Metchnikoff! Rather, it took two people: Metchnikoff's scientific career was so incredible and his personal life so interesting that you can't really expect one person to encompass it all. Moreover, Metchnikoff was such a complex and, at times, contradictory person that two authors' viewpoints are actually more appropriate to have than one. The richness of this book is due to a most fruitful interaction between the American immunologist Alfred Tauber and the Russian philosopher Leon Chernyak. Those of us who have enjoyed their series of historical articles in *Cellular Immunology* already know the vitality of their scholarship; but those articles were only the embryonic form of this book.

I expect that many immunologists reading those initial papers were surprised to discover that Metchnikoff's discipline-creating theory of "active host immunity" originated within the matrix of comparative embryology. For although Metchnikoff is considered the founder of the notion of active host immunity against disease and, hence, the founder of the field of immunology, he did not do so out of an interest in medicine. Rather, Tauber and Chernyak have traced these roots of immunology back to the revolution in embryology when traditional comparative embryology began incorporating evolutionary concepts in the late 1860s.

This evolutionary embryology was a remarkably rich mulch, and the embryonic shoots of many of our most successful disciplines have their roots in this strange soil. Thomas Hunt Morgan and E. B. Wilson, the principal founders of modern genetics, did their original research in this area and so did Hans Spemann, Wilhelm Roux, and many of the other founders of experimental embryology. In this volume, Tauber and Chernyak demonstrate that modern immunology is also deeply rooted in evolutionary embryology. It should be noted that comparative and evolutionary embryology were extremely strong in Russia and the Baltic region, and historian Fred Churchill has recently shown that modern comparative embryology originated there. Christian Pander (1794–1865), the discoverer of the germ layers, was born in Riga; Karl Ernst Baer (1792–1876), the discoverer of the mammalian egg and the process of neurulation, was born in Dorpat (now Tartu, Estonia); and Heinrich Rathke (1793–1860), the preeminent comparative embryologist who discovered the mammalian gill clefts and who focused most of his research on vertebrate urogenital sys-
terns, was born in Danzig (now Gdansk). These three embryologists knew each other well and had interests in comparing the embryogenesis of different animals. These investigators inspired a second generation of embryologists in Russia, a group that included Elie Metchnikoff, Nicolaus Kleinenberg, and Alexander Kowalevsky. All three of these investigators sought to link animal development with evolutionary biology.

Metchnikoff was a comparative embryologist, and a very good one. One of the first comparative embryologists to study invertebrates, Metchnikoff was ideally situated to discuss the origins of metazoans. In combatting the competing theories of Ernst Haeckel, Metchnikoff created a hypothesis for the origin of metazoans that is still the basis for our current theories. Libby Hyman explicitly linked her theories to those of Metchnikoff, and much of Leo Buss’s current hypothesis on the origin of metazoans is based on Metchnikoff’s principles and examples. As Tauber and Chernyak document, Metchnikoff entered into immunology through his attempt to prove that embryonic mesodermal cells had an intrinsic capacity for phagocytosis and that the earliest metazoans, like the earliest embryonic stages, had a solely intracellular mode of digestion. This digestion was accomplished, Metchnikoff asserted, by the ameboid cells of the mesoderm. He would later frame the hypothesis that this primitive digestive function became a property of specialized phagocytes (i.e., macrophages) that would engulf and digest foreign objects such as pathogenic bacteria. This notion that the intracellular digestion found in protists would eventually give rise to the properties of immunocompetent cells is still a basic concept in modern immunology. Throughout his scientific career, Metchnikoff productively linked digestion, immunology, and evolution.

Metchnikoff is usually remembered neither for his hypothesis of metazoan origins nor for his assertion that phagocytosis is the function by which one can trace the mesodermal cell lineage. He is mostly known for his concept of active host resistance to infection. Tauber and Chernyak demonstrate that Metchnikoff’s theory of active host resistance—that the body had cells that provided innate immunity to infectious agents—was the result of both his embryological theories and a particular philosophical view of the body that grew out of them. This philosophy saw the body not as the product of harmonious interactions beginning with the fertilized egg, but as a struggle within the body between potentially disharmonious parts. What created this whole out of such parts? What harmonized the potentially competitive lineages? One of these harmonizing whole-making functions belonged, according to Metchnikoff, to the mesodermal phagocytic cells. These cells were essential for providing nutrition for the developing organism and would later defend the organism against external pathogens. Believing (as did his mentor Louis Pasteur and his adversary Paul Ehrlich) that immunity was linked to nutrition, Metchnikoff brought the first yogurt cultures into France to counter the putatively deleterious effects of toxin-producing colonic bacteria and thereby to promote longevity.

Metchnikoff was a scientist in the Romantic tradition. Like Pasteur, he saw science as the cure for the evils that have plagued humankind. Metchnikoff saw the scientist as savior to the world, and he put his religious faith and fervor into science. He was also a scientist who would survive two suicide attempts, engage in vitriolic polemics against his rivals, and who would become a leader of that most French establishment,
the Pasteur Institute, even though he was a half-Jewish Russian immigrant. Although Metchnikoff received a Nobel Prize (with Ehrlich) in 1908, his immunological theories were eclipsed soon afterwards. Ehrlich and his school had formulated a humoral antibody theory of immune responsiveness upon the scaffold of Metchnikoff’s theory of active host response. Only recently, after acknowledging macrophage activity in the generation of the humoral immune response and in the innate immunity to specific pathogens, can we see the importance of this scaffold that underlies and supports all subsequent theories of immunity.

The story of Metchnikoff’s life and science is a story of arguments; for Metchnikoff had an uncanny ability to bring out the polarities present at any given time. Therefore, in documenting the origin, acceptance, and eclipse of Metchnikoff’s theory, Tauber and Chernyak provide a view into the larger story of the changes occurring in embryology as it attempted to incorporate notions of evolution and the changes in pathology and medicine as they met the sciences of bacteriology and cytology. The story of Metchnikoff becomes our vantage point to see how a science became accepted by medicine during an era when medicine was just beginning to find its scientific bases. We see biology and medicine as each group reacted to Metchnikoff’s central hypotheses. There were the arguments with Kowalevsky (over the nature of homology), the arguments with Haeckel (over the origins of phyla), the arguments with Baumgarten and Ziegler (over the nature of inflammation and the host response), and the well-known arguments with Ehrlich and the humoralist immunologists over the nature of that host response. Throughout these debates and polemics, Metchnikoff maintains his hypothesis that phagocytosis is the fundamental integrating activity of the organism, first for its role in embryonic digestion and then for its role in protecting the body from infection.

This volume is, therefore, a history of that fascinating era when embryology had to integrate evolutionary biology and when medicine had to integrate cellular science. That Metchnikoff played critical roles in both transformations is remarkable and understandable only in the light of his ideas on phagocytosis. Tauber and Chernyak meticulously trace this intellectual odyssey from its origins in the germ-layer controversies of Russian embryology to the immunological laboratories of Paris.

We are extremely fortunate to have this excellent volume, and I expect that this is but the first and seminal volume of an entire library of new Metchnikoff studies. What this book does is to pare away a great deal of Metchnikoff mythology (much of it promulgated by Metchnikoff himself) and to document the turbulent origins and reception of one of the most important biomedical concepts of our times. In so doing, Tauber and Chernyak also show how evolutionary biology and comparative embryology converged with medical interests to formulate a new view of the organism and gave rise to the science of immunology.

Swarthmore College

July 1990

Scott Gilbert