Global Transformations *in the* Life Sciences, 1945–1980

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Introduction

Life Sciences *in the* Era *of* Decolonization, Social Welfare, & Cold War

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THE DECADES AFTER THE SECOND WORLD War brought great advances to the life sciences. Expansion in biomedical knowledge spanned issues from the foundation of molecular biology to the conceptualization of the biosphere. To a substantial degree, these advances were the cumulative results of analysis and practice in biomedical studies since the opening of the twentieth century. The effort to synthesize Darwinian evolution and Mendelian genetics led gradually to a new understanding of the mechanisms of life.[1] The creation of new instrumentation, from the electron microscope and X-ray crystallography to the inoculation gun of the antismallpox campaign, enabled new levels of precision in observation and new levels of public health efficiency.[2] The work of biochemists brought the discovery of vitamins and mass production of antibiotics, ultimately improving nutrition and limiting certain infectious diseases while expanding the pharmaceuticals industry. These advances, plus worldwide improvements in sanitation and public health, were able to extend millions of lives. Research institutions, international collaboration, and national systems of health care expanded clinical work, supporting a remarkable improvement in levels of human health worldwide. The interplay of these factors created the field of ecology and built a formidable life science establishment.

At the same time, the great conflict of the Second World War, the culmination of upheavals earlier in the twentieth century, profoundly shaped the postwar transformations in life sciences. The scientific world, along with human society in general, had been shaken seriously by the economic depression of the 1930s and especially by large-scale hostilities from 1937 to 1945.[3] The war itself was probably the most destructive in human history, with huge numbers of military and civilian casualties, ending with two atomic explosions. The Axis powers began the war with nationalistic expansion and pursued the fighting as a campaign for racial hierarchy, with devastatingly direct results in much of Europe, Asia, and the Pacific as well as indirect effects elsewhere. The total Axis defeat led to a forceful affirmation that racial hierarchy would no longer be a governing principle of the world order. While implementation of that priority required generations, the victorious coalition and mobilized societies moved rapidly to expand the scale of many human institutions and arenas of social practice, moving toward general recognition of human rights in principle.[4] The prewar exploration of eugenics, with its racialistic tinge, declined sharply. More broadly, an immense postwar effort arose at all levels to halt further conflict and to purge the hatreds that had fed warfare. A powerful if momentary global consciousness called for creation of institutions and alliances for worldwide welfare.

Two great powers survived the war: the United States, whose economic power and physical distance from the fighting put it in a position of great strength; and the Soviet Union, which bore the heaviest costs on the ground but managed somehow to grow in strength during the war. The polarization of the world in nuclear stalemate, opposing the resulting two armed camps, has commonly been seen as the principal driving force for the evolution of postwar history, in scientific change as in sociopolitical transformations. Yet other postwar processes, notably decolonization and the growth of international organizations, were also influential.

In this collection of studies on the life sciences, we seek to account for both the long-term evolution of scientific practice and the sudden impact and consequences of world war. The framework of study extends temporally to the whole twentieth century but focuses on the years 1945–80; it addresses the processes of evolution in numerous life science fields and subfields; and it explores the scientific consequences of major postwar social processes. In exploring this wide range of scientific and social issues, the authors have identified relationships that, in our opinion, add new knowledge and call for further study.[5]

This volume emphasizes three related issues in life sciences in the postwar era. First is that the impulse to emphasize social welfare, in response to the destruction and mortality of war, brought high priority to campaigns—distinctive for each world region—that improved conditions in health and education to a remarkable degree. On the whole, these campaigns at once drew on and accelerated changes in the life sciences, providing real-world laboratories where new theories and technologies could be tested, implemented, and revised. Decolonization—for Asia, Africa, and the Caribbean—was the biggest arena for advances in health in 1945–80. Parallel campaigns advanced health conditions through the welfare states of Western Europe, the pragmatic programs of North America, the institutions built under state socialism, especially in Eastern Europe, and the programs of populist regimes in Latin America. International organizations, forming immediately after the war, played a substantial role in applications of life sciences.[6] Development—in effect, an ideology of social engineering—remained prominent throughout the postwar generation, though with contestation between those who understood "development" in terms of economic growth and those who saw it as community welfare.[7] From the lab to the field, these monumental shifts colored changes across the life sciences. Cold War confrontation affected the life sciences in interaction with the factors just listed; overall, it had rather less importance for the life sciences than for natural sciences, especially physics, and engineering.[8]

The second main emphasis of the volume is how prewar advances—in biochemistry, public health, and in articulating a neo-Darwinian thesis (or modern synthesis)—laid the groundwork for postwar improvements in global health, but these scientific advances required the high priority of social welfare to bring about the investment that enabled the campaigns to succeed. The pace of discovering the mechanism of genetic reproduction was accelerated by the introduction of modeling from physics beginning in the 1930s, as has been established in the literature on molecular biology. The life sciences included a wide range of subfields at all levels—eugenics, dermatoglyphics, infectious disease, urgent anthropology—which did not all thrive but recur periodically. Further, the practical implications of development programs, many of them unexpected, led to growing concern for environmental studies and conservation efforts.

Our third emphasis is on the restructuring and integration of relations among life science fields. The postwar context facilitated interregional and interdisciplinary approaches to pursuing the life sciences that had the transformative effect of reducing the importance of internal-external

and basic-applied dichotomies that had characterized pre–Second World War science. Thus, Vannevar Bush's 1946 manifesto, *Endless Horizons*, emphasized the primacy of government investment in basic research. Yet subsequent scholarship downplays the significance of the dichotomy of basic versus applied science, as well as the dichotomy separating the internal evolution of science from external influences.[9] The chapters here, while focusing on the specificity of developments in selected arenas, bear out the validity of recent interpretations in their documentation and analysis of the interplay among numerous and expanding elements of the life science professions. Indeed, the integration of many elements in life sciences became clear by the 1990s with the expansion of biotech and conservation studies.

The chapters in this volume range widely over the issues in life sciences, in research, applications, and administration. From the smallest to the largest scale of biomedical study, they range across biochemical development of synthetic forms of the alkaloid curare for use in anesthesia, contributions to emerging neuroscience by scholars who had escaped their German homeland in the 1930s, diagnostic research on throat cancer, the program of smallpox eradication, phenotypical studies of skin ridges, academic exchange in sexology, the practice of general medicine by internationally migrating physicians, a campaign of "urgent anthropology" to document rapidly changing cultures, classification of flora and fauna threatened with extinction, the preparation and dissemination of biological textbooks, and the formulation of scientific policy by United Nations Educational, Scientific and Cultural Organization (UNESCO) structures. The chapters richly touch on each of these discrete areas of study but also on the other social and professional issues affecting postwar science. All the chapters involve international connections and most of them highlight the work of international organizations, both formal and informal.

Historians of science, in thinking of the past several centuries of scientific study, have been asking how best to place the history of science in global context. Sarah Hodges notes the analytical benefits of the rise of social history of medicine in the 1980s, and asks whether the subsequent studies with a global focus have lost track of power relations. Kapil Raj looks back to the founding texts of Needham and Basalla—the former questioning why China did not lead the scientific revolution and the latter arguing for the diffusion of science from Europe to the world. Raj offers notions of circulation and knowledge making as improved frameworks for study of science.[10] Fa-ti Fan expresses skepticism about Bruno Latour's

view of centers of calculation, preferring Raj's emphasis on spaces of circulation of scientific knowledge—which, in turn, has similarities to Peter Galison's notion of trade in physics (involving exchange among parallel scientific subcultures), and to Mary Louise Pratt's notion of contact zones that link knowledge in a situation of asymmetrical power.[11] Sujit Sivasundaram emphasizes the benefits of reading widely and using documents for unexpected purposes: he tells tales of using Scottish missionary sources to reveal perspectives of Tahitians and of using palm-leaf manuscripts from Ceylon as a key to reading European botanical gardens. Sivasundaram, along with others, sees merit in applying Bourdieu's theory of practice to the exploration of scientific practice.[12] David Chambers and Richard Gillespie, followed by Carla Nappi, emphasize localities as components of the global history of science.[13] We seek to apply these insights to the subject matter at hand.[14]

We use the term "global" not only in geographical terms but also to encompass various scales of social and academic life. The field of world history has featured efforts not only to expand the geographic scope of studies but to include a full range of the temporal and topical dynamics of global interaction. In particular, world historical analysis currently challenges interpretations relying on diffusion of innovations from a putative global center or giving excessive emphasis to top-down and civilizational interpretations. In contrast, current world historiography involves developing techniques for tracing historical interactions—in this case, interactions yielding the creation, discovery, and exchange of scientific knowledge—in all directions, to document the equilibrium of a social system or to locate erratic system behavior. For instance, Sebastian Conrad uses the example of steps in the adoption of Western timekeeping in Japan to note that a change in technology results not only from a connection to make new technology available but a social reason to make it productive.[15]

We hope that these studies, when combined with parallel studies, will contribute to revealing the elements of a global and globally tightening system of knowledge about the life sciences in the postwar era.[16] As the contributions to this volume will show, the life sciences developed along many different axes and at scales from the molecular to questions of mass extinctions of species.[17] Among those axes, the scientific work motivated by decolonization and the era of social welfare was innovative in many ways: it both contributed to and relied substantially on the main line of evolving biomedical knowledge.

Of all the great postwar changes, decolonization most strikingly re-

shaped the world order. In Asia during the 1940s, in Africa from the 1950s to the 1970s, and in island and other territories from the 1960s, nations gained independence in a restructuring that not only created governments responsible to their national constituents but also shifted the balance of global politics.[18] The territories occupied by Japan, from Manchuria to Burma, underwent at least two politico-military transformations within a decade. While decolonization liberated new nations from wartime occupation and former colonial masters, scientific communities were disrupted and finances for necessary expenditures, such as lab equipment, became subject to new vicissitudes of economic transformation. In many cases, institutions of higher learning needed to be constructed and existing structures faced shortages of qualified personnel. As John Merson has written, the era of decolonization did not necessarily end the former colonies' dependency on the science and technology of former imperial centers.[19] With that in mind, however, many newly independent nations saw in the life sciences the promise of development and nation-building, offering shortcuts to improving health, agriculture, and nutrition.[20]

The advances in social welfare in ex-colonial countries up to 1980 were extraordinary. While the ex-colonial regions did not experience rapid rates of economic growth, especially per capita, the levels of literacy and the average expectation of life at birth rose at remarkably high rates. Average African life expectancy at birth rose from less than thirty-five years in 1940 to almost fifty years in 1980; Asian equivalents were from less than forty years in 1940 to sixty years in 1980.[21] Literacy rates are hardly known at all for Asia and Africa in 1940, but had risen to rates ranging from 30 percent to 60 percent of adults by 1980 and have continued to rise since. The implementation of old-age pensions, workers' compensation, and other forms of social insurance also began in this era, with the support of the International Labor Organization.[22] Meanwhile, debates and shifts in racial categorization persisted through the postwar era. Formal racial segregation was challenged in country after country; programs of "affirmative action" were implemented in India, Malaysia, and then in the United States.

Social welfare was a similarly important theme throughout the postwar world. The era from 1945 to 1980 was a time of relative social equality worldwide—that is, a time of unusual minimization of social inequality.[23] The studies of Thomas Piketty, focusing on the major capitalist economies, show a sharp drop in economic inequality during the Second World War to a level that remained roughly constant until 1980. In addition, comparisons across the planet during the postwar generation show that national

investment in social services of health, education, and employment was unusually high in all parts of the world. Remarkable parallels appear in comparisons of Western Europe, the United States, Latin America, Japan, the Soviet Union, Eastern Europe, and in Asia and Africa. In Western Europe, programs that became explicitly known as "the welfare state" were established by social-democratic governments.[24]

The expansion of large-scale institutions in government, economy, and society not only characterized the immediate postwar era but has continued in various forms ever since. The United Nations was to be the core of a wide range of international organizations. Of particular importance from the perspective of science was UNESCO—its mission in education included natural sciences, social sciences, human sciences, and cultural affairs. This expanded wave of international organizations marked a new era of international institutional forces that regularly brought scientific actors from across the globe into contact with one another and raised a mix of concerns about development, conservation, race, mobility, and the developing understanding of thinking in terms of systems.

The founding director-general of UNESCO (1946–48), the British-born biologist Julian Huxley, became an outspoken advocate for internationalism in the full range of UNESCO's newly defined scope.[25] In UNESCO, the International Council of Scientific Unions (ICSU) was rechartered and expanded as the coordinating body for natural sciences. An array of international scientific unions, disciplinary-based organizations, and national academies of sciences filled out this academic map. Within the natural sciences, the physical sciences of physics, chemistry, and geology were best organized, while the life sciences had less access to resources.[26]

UNESCO was founded in the atmosphere of Huxley's brimming enthusiasm for international collaboration. There were reasons for skepticism from various directions. American officials saw Huxley's outlook as too close to socialism, and managed to limit his appointment to two years. Those from the colonial regions knew of Huxley's earlier association with eugenics, and in any case the colonial regions were not central to early UNESCO projects. As Sanjoy Bhattacharya warns, these United Nations–affiliated organizations should not be viewed as monoliths.[27] Rather, these new international structures were agglomerations of a multitude of sometimes divergent interests. The goals and methods associated with the "center" (whether Geneva, New York, or elsewhere) did not always align with what unfolded "in the field." As historians, we need to question how "global" these new scientific bodies truly were. Despite the internationalism of

Huxley, the body would become subordinated to Euro-American interests for a time.[28] As Patrick Petitjean has underscored, this period was marked by competing types of scientific internationalism.[29] In response, there were even attempts to craft "neutral science" to avoid this type of competition.[30]

The Cold War dimension of the postwar life sciences is necessarily a part of this volume's analysis. The recent collection edited by Naomi Oreskes and John Krige centers on the debate in which Paul Forman argued that U.S. physical scientists, while receiving Cold War military largesse for their studies, shifted their outlook in response to official priorities, while Daniel Kevles responded that the evidence does not support this case.[31] The issue has now been debated across multiple fields: the results have documented various transitions in the relations of government and scientific research without resolving the debate. The Cold War doubtlessly served as a central driver of scientific development in physics and engineering within this era. Within the life sciences, however, the Cold War dimension never became as central as in the physical sciences.[32]

In a remarkable example of the interaction among the various national programs of social welfare, David Wright, Sasha Mullally, and Renée Saucier (chapter 1) trace the movement of medical professionals, trained in India's expanding institutions of medical education, to employment in the United Kingdom and then to North America. Theirs is a contrast of the notions of brain drain and brain gain, focusing particularly on the flood of scientific and medical experts leaving India for the West during the 1950s, 1960s, and 1970s. Britain, Canada, and the United States benefited immensely from this deluge of highly trained physicians. Implicit in the authors' argument, once one accounts for the contemporary improvements in health conditions within India, is that the training of physicians in India was expanding sufficiently to meet growing domestic demand, while also training numerous medical professionals who emigrated. That this "brain drain" presented a problem for India is without doubt; such a problem was not uncommon in the postcolonial context. Yet as Wright, Mullally, and Saucier demonstrate, the much-heralded universal health care services that became linchpins of the welfare state in both Canada and Britain were largely possible because of an in-migration of physicians from the developing world. Although economic aid flowed from the West to former colonies, scientific and medical migrants represented a sort of "aid in reverse."

The ethos of decolonization expanded to include Latin America. As Daniele Cozzoli shows (chapter 2), the postwar studies of researcher Daniel Bovet, who had moved from France to Italy at the end of the war, involved

expeditions to Amazonia and required the formation and management of new transnational collaborations between scientists in Europe and South America. The Italian Higher Institute of Health encouraged Bovet's work to achieve recognition for its collaboration with Brazil and with the newly established World Health Organization (WHO). Bovet's research on curare—used as a muscle relaxant in its natural and synthetic forms—yielded him a 1957 Nobel Prize and reflected a mastery of the postwar conditions of scientific research.

"Development" was another policy concern, related to social welfare, that gained more attention than ever before in the postwar era.[33] Development programs, at all levels, proposed to rely on human agency to transform and improve the environment. Medical advances to prolong life were among the most inspirational examples of development and the optimism that it set forth: the great hopes placed on the insecticide DDT and the antibiotic penicillin were examples of the postwar logic of development. Those in the scientific community became devoted, in some cases, to the cause of development, reorienting their research around it; in other cases, scientists sought more opportunistically to appropriate resources from development programs to support their existing research. In one sense, competing national and corporate units sought to use science as an instrument for development, exploiting the natural world in new, more efficient, and sometimes more devastating ways.

In an international development collaboration, Chinese–American collaborations in the field of cancer research, as documented by Lijing Jiang (chapter 5), center on the research of the physician Li Bing, who developed an effective system for screening esophageal cancer that laid the groundwork for a national cancer survey in the 1970s. The cancer survey, in turn, encouraged the work of T. Colin Campbell of Cornell University, who was able to conduct a very broad 1983 nutrition survey in China. These two surveys, important in cancer studies generally, took place at a time when Chinese–American contacts and the Chinese social situation were propitious. Over time, however, the rapid transformation of China and the modernization of Chinese biotechnology, partially products of this scientific collaboration, eroded the ability to conduct the sweeping epidemiological studies that had made the collaboration so productive in the first place.

The WHO-sponsored campaign for the eradication of smallpox, launched in the midst of the Cold War in 1958 and ending in 1977, was in one sense a strongly humanitarian campaign. Bob H. Reinhardt traces the United States–led portion of the campaign in Africa through the Centers

for Disease Control (chapter 3). He demonstrates the tensions between scientific advancement, health improvement, and economic development, underscoring the ways in which some of those involved in the American campaign later reinterpreted smallpox eradication as a (lost) opportunity to catalyze broader socioeconomic changes in Africa.

The question of conservation of the natural world, while rarely the leading item on the life science agenda, rose occasionally to prominence. In the postwar era, Rachel Carson's detailed 1962 cri de coeur in response to the effects of DDT on bird populations brought a widespread response that led by the 1970s to national bans on DDT in many countries, though not before DDT-resistant mosquitoes had appeared.[34] This instance of the tension between development and conservation was soon seen to extend to a range of parallel cases, such as threatened human communities. Adrianna Link (chapter 10) details the nascent discipline of urgent anthropology, an academic response, focused in the years 1964–84, to identifying and documenting threatened and rapidly shrinking human populations. The founders of urgent anthropology, drawing on ecology and conservationism, sought to preserve an ethnographic record of human diversity and the relationship between vanishing groups and their environments. Looking specifically at the urgent anthropology program developed under the auspices of the Smithsonian Institution, Link demonstrates that this emerging discipline, centered in the United States, developed a distinctly international identity.

The most widely publicized development in postwar life sciences was the emergence of molecular biology and the growing understanding of biological replication and heredity brought about by research in this field. The details of these discoveries have been written up widely and effectively.[35] Of the numerous key steps in this process, here is a brief selection: Oswald Avery confirmed in 1944 that nucleic acids rather than proteins were the basis of genes; James Watson and Francis Crick announced the double-helix structure of DNA in 1953; messenger RNA was documented in 1960; and in 1961 Marshall Nirnberg's group completed the initial validation of the DNA code for selecting an amino acid, phenylalanine. While it took some time for the benefits of these discoveries to influence practice in other life science fields, biological studies as a whole gained an informal sense of unification through these advances in learning the underlying code of life.[36]

UNESCO facilitated the interconnection of international academic unions throughout the natural sciences, the social sciences, and the humanities. Kateřina Lišková (chapter 7) describes the participation of

Czechoslovak scholars in sexology during the postwar years, focusing on a 1968 international meeting of sexologists held in Prague. Research in sexual science had enjoyed a long tradition in Czechoslovakia, as the Sexological Institute had been established in 1921; after the Second World War a group of medical doctors worked there without disruption for the duration of state socialism and beyond. Lišková demonstrates the Cold War dimension of discourses during the 1968 congress, particularly how broader ideas in which both East and West embedded their regimes shaped approaches to human sexuality—in the Czechoslovak case, a shift from "pliable" social grounds attributed to deviance as perceived in the early, utopian phase of the regime to the fixed biological grounds in the late stage of the regime that was, correspondingly, rigid. By and large, Western sexologists at the 1968 meeting clung to the notion that sexuality was biologically fixed. In contrast, Eastern experts identified culture—theoretically open to change—as the chief driver of sexuality. The UNESCO framework enabled the broader discourse to continue in sexology and in many other disciplines.

Doubravka Olšáková (chapter 6) traces the UNESCO career of Viktor Abramovich Kovda, a soil scientist who became, in 1959, head of UNESCO's Natural Sciences Department. As he came to office, the Soviets had rapidly become influential proponents of the International Geophysical Year (IGY) and the program for smallpox eradication. From his vantage point, Kovda had great influence over the formulation of the International Biological Program (IBP), 1964–74. Following the success of the IGY, plans for a parallel IBP began within the International Union of Biological Sciences, headed by G. Montalenti of Italy, with a focus on genetics. Olšáková shows how Kovda and his colleagues from Eastern Europe planned carefully to maximize their voting strength, so that the principal agenda of the IBP was gradually revised from genetic studies to an emphasis on ecology and environmental science. By 1963 it was agreed that the subtitle of the IBP would be "The Biological Basis of Productivity and Human Welfare."[37]

By its conclusion in 1974, more than seventy countries had participated in the IBP, completing hundreds of research projects on a diverse range of studies including the "production ecology of ants and termites," the "higher fungi of the Estonian peatlands," and the "biology of high altitude peoples." Cambridge University Press would go on to publish more than two dozen volumes dedicated to synthesizing the research carried out under the auspices of the IBP. In one notable IBP success, the biomes project, backed heavily by the American government, produced computer models

of entire ecosystems, which were instrumental in promoting the systems approach to studying ecology.[38] Nevertheless, financing the IBP had also been a consistent problem; loans from UNESCO and the ICSU were needed to keep things afloat, a problem worsened by the beginnings of global economic stagnation. As one commentator noted midway through the project, "The more innocent biologists had clearly been misled by the vast sums of the International Geophysical Year."[39]

The postwar tension of internationalism and nationalism emerges in a different form as seen in the study by Audra J. Wolfe (chapter 9) on American biology textbooks, prepared for the post-Sputnik age but also for export. The exported texts were to be "adapted" rather than just translated, in collaboration with local educators, to account for local biology and social conditions. At the same time, they were to emphasize scientific method over practical applications, to develop a modernizing young elite. Wolfe thus reveals how biologist educators in postcolonial societies were excited to partake in an American-led international project yet simultaneously expressed the nationalist ambitions of postcolonial societies in Asia and Latin America.

After 1980, the emergence of biotechnology and expanded attention to conservationism brought new interconnections to the life sciences. At much the same time, the postwar world underwent new economic difficulties and transformations. From the mid-1970s, the growth in prosperity and attention to social welfare that had persisted since 1945 gave way to stagnation in output, rising levels of debt, and growing labor conflict. There was no single planetary shock to mark the end of an era as had been the case in 1945; instead, a series of social transitions, apparently independent of each other, gradually signaled the opening of a new era. The petroleum crises of the 1970s raised oil prices, interest rates, and levels of debt, especially in tropical nations. Dictatorships arose in Latin America, Africa, Asia, and, more briefly, in Europe. From 1980, prosperity expanded mostly for the wealthy as rates of economic inequality grew worldwide, though the expanding economies of China and India tended to counter the global trend of stagnation.

Nationalistic sentiments had run high in the immediate postwar years, accompanying decolonization, socialist regimes, and industrial growth, yet in an atmosphere that was critical of racial categorization. From the 1980s, civilizational and even racial categorizations gained in influence. Thus, while the results arising from analysis of the human genome gave primacy to the commonality of humans, it did not take long for merchants to begin

selling DNA-testing procedures that did not identify people by their individual characteristics but classified people into national and racial groups. The rise of national sentiment in China may be one of the reasons for the rebirth there of interest in dermatoglyphics. Daniel Asen's essay (chapter 4) on this field, which begins with its emergence in the interwar years, picks up the story again in the 1980s as the energetic work of Zhang Haiguo built a thriving Chinese research community working to conduct national and ethnic classification through the study of dermal ridges on fingertips, the palms of hands, and the soles of feet. Dermatoglyphics gained in international scientific collaboration: Asen's chapter reveals how the category of race remained an important topic of exploration despite shifts in the wider political climate.

Meanwhile, increasing evidence arose to document the exhaustion of natural and human resources. As the century progressed, international bodies took an increasingly central role in discussions over how to safeguard humankind's collective future.[40] In chapter 11, Jon Agar addresses conservation but shifts the discussion to animal species on the verge of disappearing, in place of the vanishing human populations that are the topic of Link's study of urgent anthropology. Conservationists applied the term "sixth extinction" to this process, referring at the same time to five immense extinctions known from the geological record. By the late twentieth century, governments and conservationists across the world recognized that human activities threatened the survival of many types of animal species and that such a problem could only be tackled on a global scale. In this context, Agar's contribution explores how new international organizations and conservation programs implemented quantitative methods to measure whether particular species qualified as extinct, endangered, or safe. Ultimately, Agar reveals how these methods were subject to substantial scientific and political debate.

Taken as a whole, the chapters in this volume highlight the complex evolution of the life sciences in the post–Second World War period. Practitioners participated in extraordinary advances in human health and in important beginnings in the study of ecology, while resolving many mysteries of the molecular level of life. The aftermath of devastating war, the emphasis on social welfare as much as on economic growth, the end of colonial empires, and Cold War confrontation both shaped and responded to the applications in life sciences. New international institutions were capable of tackling the grandest of scientific challenges, yet they were also paralyzed by the national ambitions of their members. Political ideology

could constrain research, nationalist sentiment could redirect research, but the spirit of internationalism just as commonly prevailed. By the end of the twentieth century, wide-ranging alliances of life scientists were joining in the unprecedented exploration of biotechnology. At the same time, new understandings of ecology were put to the test in facing the rising threat of environmental degradation.

NOTES

Foreword

1. René Dubos, *Man Adapting* (New Haven, CT: Yale University Press, 1966), 7.

Preface

1. From the call for proposals: "The scope of life sciences, for our purposes, includes disciplines ranging from medicine and biology to psychology and public health, and we hope to explore the ramifications of these disciplines in other fields. . . . We seek interventions in interpretation of these fields from scholars based in history, history of science and medicine, social sciences and natural sciences. In particular, we are seeking papers that address any aspect of the life sciences from a global/world history perspective. We see the postwar history of science as a period marked by dramatic advances in knowledge of the life sciences during a time of increasing international collaboration. At the same time, new research occurred within a climate fraught with Cold War enmities and the suspicions brought on by decolonization."

Introduction

1. In a key volume, population geneticist Ronald A. Fisher argued that the specifics of inheritance, as seen through the genetics of Mendel, were consistent with the broad process of natural selection identified by Darwin; Theodosius Dobzhansky further hypothesized this neo-Darwinian synthesis. Details were filled in through decades of research. Ronald Aylmer Fisher, *The Genetical Theory of Natural Selection* (Oxford:

Clarendon Press, 1930); Theodosius Dobzhansky, *Genetics and the Origin of Species* (New York: Columbia University Press, 1937).

2. Nicholas Rasmussen, *Picture Control: The Electron Microscope and the Transformation of Biology in America, 1940–1960* (Stanford, CA: Stanford University Press, 1997).

3. The 1937 Japanese assault on China expanded previous military confrontations, the 1941 attack on Pearl Harbor brought almost all powers into the war, and war ended only with Japan's 1945 surrender, following the explosion of two American atomic bombs.

4. The United Nations Declaration of Human Rights was adopted in 1948; it was reconfirmed and expanded in subsequent decisions.

5. For a somewhat more detailed review of transformations in the life sciences during the twentieth century, see Patrick Manning, "The Life Sciences, 1900–2000: Analysis and Social Welfare from Mendel and Koch to Biotech and Conservation," *Asian Review of World Histories* 6 (2018), 185–207.

6. Especially those governed primarily by national members (UN General Assembly, UNESCO, World Health Organization, International Labor Organization). Of lesser influence on the life sciences were international organizations governed primarily by big powers (UN Security Council, International Monetary Fund, World Bank). Nongovernmental organizations gained great significance, but grew at a slower rate.

7. In addition, conflicts among contending socioeconomic interests, while long in existence, took specific social forms in the postwar era and influenced the factors above. For instance, trade union membership reached a peak and then declined in this era. The conflict between socialism and capitalism as economic systems and political parties also reached a peak in this era. Relations among wage working classes, private employers, and the state took quite different forms in Eastern and Western Europe, and the United States. In the many regions with large peasant populations, peasants were influential though never dominant.

8. For examples of Cold War interactions of various sorts in this volume, see the chapters by Reinhardt, Asen, Jiang, Olšáková, Lišková, Wolfe, and Link.

9. Vannevar Bush, *Endless Horizons* (Washington, DC: Public Affairs Press, 1946). For a substantial and updated critique of the dichotomy between basic and applied science, see Venkatesh Narayanamurti and Toluwalogo Odumosu, *Cycles of Invention and Discovery: Rethinking the Endless Frontier* (Cambridge, MA: Harvard University Press, 2016). For a debate on whether an internal-external dichotomy remains valid in understanding science, see Dudley Shapere, "External and Internal Factors in the Development of Science," *Science and Technology Studies* 4 (1986), 1–9; P. Thomas Carroll, "Incorrectness and Specific Doubts: Comments on Schapere," *Science and Technology Studies* 4 (1986), 10–14; Stephen Turner, "The Sociology of Science in Its Place: Comment on Shapere," *Science and Technology Studies* 4 (1986), 15–18; Shapere, "Replies to Carroll and Turner," *Science and Technology Studies* 4 (1986), 19–23.

10. Sarah Hodges, "The Global Menace," *Social History of Medicine* 25 (2012), 719–28; Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650–1900* (New York: Palgrave Macmillan, 2007), 2–24.

11. Fa-ti Fan, "The Global Turn in the History of Science," *East Asian Science, Technology and Society* 6 (2012), 249–58; Peter Galison, "Trading with the Enemy," in

Trading Zones and Interactional Expertise: Creating New Kinds of Collaboration, ed. Michael E. Gorman, 25–52 (Cambridge, MA: MIT Press, 2010); Mary Louise Pratt, "Arts of the Contact Zone," *Profession* (1991), 33–40. In another variation, the term "exchange of knowledge" was developed for exploring exchanges including hierarchical relations (colonizer and indigenous, free and slave) and the contrast of state and civil society in exchanging knowledge across the lines of social encounters. Patrick Manning, "Building Global Perspectives in History of Science: The Era from 1750 to 1850," in *Global Scientific Practice in an Age of Revolutions, 1750–1850*, ed. Patrick Manning and Daniel Rood, 8–16 (Pittsburgh: University of Pittsburgh Press, 2016).

12. Sujit Sivasundaram, "Sciences and the Global: On Methods, Questions, and Theory," *Isis* 101 (2010), 146–58.

13. David Wade Chambers and Richard Gillespie, "Locality in the History of Science: Colonial Science, Technoscience, and Indigenous Knowledge," *Osiris* 15 (2000), 221–40; Carla Nappi, "The Global and Beyond: Adventures in the Local Historiographies of Science," *Isis* 104 (2013), 103.

14. For instance, the notion of circulation might be applied to the spread of social insurance programs to many countries, while international organizations may be seen as constituting a contact zone for various contributors to research and clinical work.

15. Patrick Manning, "Locating Africans on the World Stage: A Problem in World History," *Journal of World History* 26 (2015), 605–37; Sebastian Conrad, *What Is Global History?* (Princeton, NJ: Princeton University Press, 2016), 68–69. On the many local variations within global technology, see Kenneth Pomeranz, *The Great Divergence: China, Europe, and the Making of the Modern World Economy* (Berkeley: University of California Press, 2000), 43–68.

16. The focus of this volume is thus somewhat distinct from that of the existing historiography on twentieth-century history of science. For instance, the numerous books tracing the emergence of molecular biology address few of the specifics addressed here, while the major collection on Cold War science, published only slightly before this volume and addressing the same span of years, center on physical sciences and great-power contention. Naomi Oreskes and John Krige, eds., *Science and Technology in the Global Cold War* (Cambridge, MA: MIT Press, 2014).

17. See the concise but excellent overview of these axes and scales in Peter J. Bowler and John V. Pickstone, "Introduction," in *Cambridge History of Science*, vol. 6, *The Modern Biological and Earth Sciences*, edited by Peter Bowler and John Pickstone, (Cambridge: Cambridge University Press, 2009), 8–12.

18. From the original 51 charter members of the UN, membership grew to 60 in 1950, 99 in 1960, 127 in 1970, and 154 in 1980. The voting power of new nations in the General Assembly of the United Nations and of UNESCO ensured that the perspectives of these nations would be respected in one way or another.

19. John Merson, "Bio-prospecting or Bio-piracy: Intellectual Property Rights and Biodiversity in a Colonial and Postcolonial Context," *Osiris* (2000), 282–96.

20. For a discussion on the historiography of colonial and postcolonial science, see Suman Seth, "Putting Knowledge in Its Place: Science, Colonialism, and the Postcolonial," *Postcolonial Studies* 12, no. 4 (2009), 373–88. See also Kapil Raj, "Beyond Post-

colonialism . . . and Postpositivism: Circulation and the Global History of Science," *Isis* 104 (2013), 337–47; Christophe Bonneuil, "Development as Experiment: Science and State Building in Late Colonial and Postcolonial Africa, 1930–1970," *Osiris* 15 (2000), 258–81; David Arnold, "Nehruvian Science and Postcolonial India," *Isis* 104 (2013), 360–70.

21. James C. Riley, "Estimates of Regional and Global Life Expectancy, 1800–2001," *Population and Development Review* 31, no. 3 (September 2005), 537–43.

22. Aiqun Hu, *China's Social Insurance in the Twentieth Century: A Global Historical Perspective* (Leiden: Brill, 2015).

23. For global studies, see Thomas Piketty, *Capital in the Twenty-First Century* (Cambridge, MA: Harvard University Press, 2014); Branko Milanovic, *Global Inequality: A New Approach for the Age of Globalization* (Cambridge, MA: Harvard University Press, 2016). For a global commentary that includes national and continental specifics for all world regions, see Pat Hudson and Keith Tribe, eds., *The Contradictions of Capital in the Twenty-First Century: The Piketty Opportunity* (Newcastle upon Tyne: Agenda, 2016).

24. J. P. MacKenbach, "The Persistence of Health Inequalities in Modern Welfare States: The Explanation of a Paradox," *Social Science and Medicine* 74 (2012), 761–69; Johan P. MacKenbach and Martin McKee, "Social-Democratic Government and Health Policy in Europe: A Quantitative Analysis," *International Journal of Health Services* 43 (2013), 389–413.

25. Huxley's rapidly produced manifesto is an outstanding statement of the universalist view that prevailed briefly in the postwar atmosphere. Julian Huxley, *UNESCO: Its Purpose and Its Philosophy* (Paris: Preparatory Committee for the United Nations Educational, Scientific, and Cultural Organization, 1946).

26. For an excellent history of the ICSU, originally founded in 1931, see Frank Greenaway, *Science International: A History of the International Council of Scientific Unions* (Cambridge: Cambridge University Press, 1992). It notes, for instance (p. 72), that Huxley became director-general of UNESCO in 1946 only after brief service by Sir Alfred Zimmern.

27. Sanjoy Bhattacharya, *Expunging Variola: The Control and Eradication of Smallpox in India* (Delhi: Orient Blackswan, 2006).

28. Other internationalist forces, such as the World Federation of Scientific Workers, were themselves co-opted by forces favorable to the Soviet Union. Michelle Brattain, "Race, Racism, and Antiracism: UNESCO and the Politics of Presenting Science to the Postwar Public," *American Historical Review* 112, no. 5 (2007), 1386–413; Glenda Sluga, "UNESCO and the (One) World of Julian Huxley," *Journal of World History* 21, no. 3 (2010), 393–418.

29. Patrick Petitjean, "The Joint Establishment of the World Federation of Scientific Workers and of UNESCO after World War II," *Minerva* 46, no. 2 (2008), 247–70.

30. Bruno Strasser, "The Coproduction of Neutral Science and Neutral State in Cold War Europe: Switzerland and International Scientific Cooperation, 1951–1969," *Osiris* 24, no. 1 (2009), 165–87.

31. Oreskes and Krige, *Science and Technology*. For further analysis of this issue, see Audra Wolfe, *Competing with the Soviets: Science, Technology, and the State in Cold War America* (Baltimore: Johns Hopkins University Press, 2013).

32. For more on the Cold War debate, see Paul R. Josephson, *New Atlantis Revisited: Akademgorodok, the Siberian City of Science* (Princeton, NJ: Princeton University Press, 1997); Paul R. Josephson, "War on Nature as Part of the Cold War: The Strategic and Ideological Roots of Environmental Degradation in the USSR," in *Environmental Histories of the Cold War*, ed. J. R. McNeill and Corinna R. Unger, 21–49 (New York: Cambridge University Press, 2010); Mark Solovey, "Science and the State during the Cold War: Blurred Boundaries and a Contested Legacy," *Social Studies of Science* 31, no. 2 (2001), 165–90; Mark Solovey, "Cold War Social Science: Spectre, Reality, or Useful Concept?" in *Cold War Social Science: Knowledge Production, Liberal Democracy, and Human Nature*, ed. Mark Solovey and Hamilton Cravens, 1–24 (New York: Palgrave, 2012); Oreskes and Krige, *Science and Technology*; Allen Hunter, *Rethinking the Cold War* (Philadelphia: Temple University Press, 1998). For examples drawn from the life sciences, see Dora Vargha, "Between East and West: Polio Vaccination across the Iron Curtain in Cold War Hungary," *Bulletin of the History of Medicine* 88, no. 2 (2014), 319–42; S. Marks and M. Savelli, "Communist Europe and Transnational Psychiatry," in *Psychiatry in Communist Europe*, ed. Mat Savelli and Sarah Marks (New York: Palgrave, 2015), 1–26.

33. Frederick Cooper and Randall M. Packard, eds., *International Development and the Social Sciences: Essays on the History and Politics of Knowledge* (Berkeley: University of California Press, 1998).

34. Rachel Carson, *Silent Spring* (Boston: Houghton Mifflin, 1962).

35. Of the many fine works on molecular biology, the work of Michel Morange is excellent in describing the logic and steps in research. Michel Morange, *History of Molecular Biology*, trans. Matthew Cobb (Cambridge, MA: Harvard University Press, 1998). Other key works include Rasmussen, *Picture Control*; Lily E. Kay, *The Molecular Vision of Life* (Oxford: Oxford University Press, 1993); Pnina Abir-am, "The Molecular Transformation of Twentieth-Century Biology," in *Science in the Twentieth Century*, 495–524; Soraya de Chadarevian and Harmke Kamminga, *Molecularizing Biology and Medicine: New Practices and Alliances* (Amsteldijk, Netherlands: Harwood Academic, 1998); Chadarevian, *Designs for Life: Molecular Biology after World War II* (Cambridge: Cambridge University Press, 2002).

36. In addition to the growing general sense of unity within biology, Vassiliki Betty Smocovitis has documented two specific campaigns for theoretical unification in biology: that for an evolutionary synthesis, led in the 1930s by Theodosius Dobzhansky (and followed in 1946 by the formation of the Society for the Study of Evolution), and the emergence of evolutionary biology, articulated in the 1960s by Edmund O. Wilson and Herbert J. Ross. Vassiliki Betty Smocovitis, *Unifying Biology: The Evolutionary Synthesis and Evolutionary Biology* (Princeton, NJ: Princeton University Press, 1996), 20–21, 170.

37. "As a consequence of the rapid rate of increase in the numbers and needs of the human populations of the world and their demands on the natural environment, there is an urgent need for greatly increased biological research." "International Biological Programme: Report of the Planning Committee, November 15th, 1963," *Bioscience* 14, no. 4 (1964), 43. See also Greenaway, *Science International*; and IBP—Report of the

Planning Committee, November 15, 1963. Archives of the Academy of Sciences of the Czech Republic, ČSAV—secretariat, arch. file 10, IBP Planning Committee, 1963, 1.

38. Chunglin Kwa, "Representations of Nature Mediating between Ecology and Science Policy: The Case of the International Biological Programme," *Social Studies of Science* 17, no. 3 (1987), 413–42.

39. N. W. Pirie, "Introduction: The Purpose and Function of the International Biological Programme," *Proceedings of the Nutrition Society* 26, no. 1 (1967), 125.

40. See, for instance, Iris Borowy, *Defining Sustainable Development for our Common Future: A History of the World Commission on Environment and Development (Brundtland Commission)* (London: Routledge, 2013).