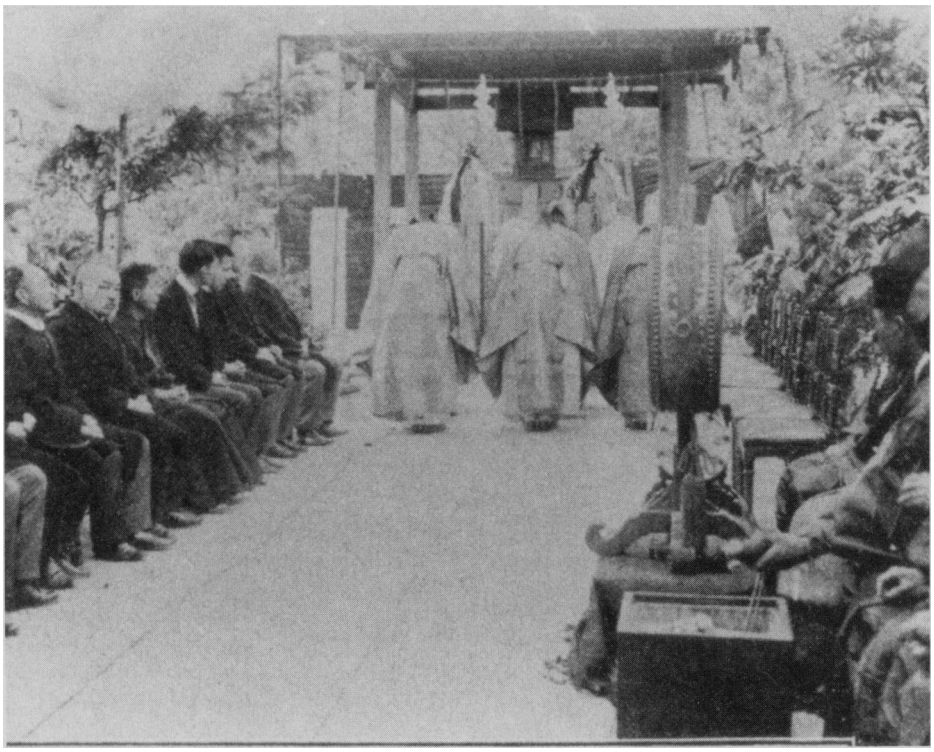
An Emergence in Science

The Formation of Science in Japan. Building a Research Tradition. JAMES R. BARTHOLOMEW. Yale University Press, New Haven, CT, 1989. xx, 369 pp. + plates. $30.

The widespread criticisms of Japan's basic research capacity have often obscured the magnitude of the nation's accomplishment in rising into the ranks of the world's science and technology superpowers in little more than a century, from a singularly unpromising background in Tokugawa feudalism. James Bartholomew's book, which describes the development of the infrastructure of Japanese science from 1868 to 1920, provides a rich, scholarly, and often contentious portrayal of the early years of Japan's scientific research institutions. Deeply grounded in Japanese sources, it is the first comprehensive treatment in English of this critically important period, and it is likely to be the standard work for many years to come.

Bartholomew's overarching theme is the interplay of indigenous and foreign influences in shaping research institutions and norms in Japanese science, with an emphasis on the indigenous, in order "to compensate for the bias of others" whose discussions have highlighted the transfer of scientific institutions and values, as well as knowledge, from the West (p. 8). The major topics through which he examines this interplay are the patterns of recruitment into the various subfields of science, government science policy, the building of research institutions, and the development of the norms of behavior for the scientific researcher.

Bartholomew begins by tracing the background of each of these topics in the Tokugawa period (1600–1867), which despite the regime's deep hostility to innovation of any kind saw the emergence of vigorous scholarly communities in medicine, both Chinese and Western (based on information filtered through the Dutch trading center in Nagasaki) and in *wasan*, a distinctive form of mathematics. Medical practitioners usually had or achieved samurai status; *wasan* came to be dominated by commoners. Bartholomew then traces this Tokugawa legacy in the patterns of recruitment in the Meiji period (1868–1912); the high proportion of samurai drawn to science; the relative isolation of mathematics from science; and the continuing dominance of medicine over other scientific disciplines (medicine accounted for 48% of the doctorates in technical fields between 1888 and 1920 and over a quarter of the chairs at the imperial universities in 1905).



"Shinto memorial service for Robert Koch, held annually at the Kitasato Institute [Institute for Infectious Diseases] on the anniversary of his birth." [From *The Formation of Science in Japan*; Kitasato Institute]

Bartholomew also finds marked continuities in public policy across the years, particularly in the strong official orientation to control over scientific and educational institutions, the preference for practical application over basic science, and the proclivity for putting generalists in charge of technical experts in administration (a proclivity that went into temporary abeyance in the early Meiji period but was quickly reasserted in the late 1880s and early 1890s). One interesting detail (among many that stud the book) is the government's choice of Spain as a model for Japan's patent system, because its regulations were both Western (and therefore defensible to the foreign powers) and conducive to bringing in foreign technology (p. 132).

The legacy of tradition was much weaker in institution-building, where it provided no models of research-oriented institutions. The foreign instructors who played so crucial a role in the early Meiji period and foreign study by young Japanese supplied organizational models as well as knowledge. Bartholomew traces their influence on the building of the imperial universities and on the Institute for Infectious Diseases (a government laboratory), the two arenas on which his analysis focuses. In both, research had to battle for attention—in the universities with training and with the extensive external consulting into which professors were drawn, in the Institute (which had a mandate not only to develop serums but also to produce them for the market) with serum production and with politics.

By 1920, according to Bartholomew, the interplay of tradition, Western models, and the sudden interruption of the inward flow of Western science and technology due to World War I (Japan had developed particularly close scientific links with Germany) had produced a mainstream consensus on the importance of building a basic research capability within Japan. It had also produced the basic organizational infrastructure for scientific research, but "without quite creating the researcher role" (p. 82), which remained "vaguely defined, inchoate, and surrounded by hostile forces" (p. 83). This is a fascinating contradiction, but it is one whose implications Bartholomew does little to explore, perhaps because his overriding

concern is the laudable endeavor to emphasize the strengths and achievements of Japanese science during these years, rather than to join the large chorus of critics, both Western and Japanese, of pre-war Japanese science.

With its 55 pages of endnotes and its rich and sometimes overwhelming detail, the book is not an easy one to read. Moreover, its focus on science rather than engineering and technology means that developments in private industry and in private educational institutions receive somewhat short shrift. And since the book ends with 1920, with only a very brief concluding chapter that surveys subsequent developments, the crucial interwar, wartime, and Occupation years remain uncovered by any comprehensive English-language treatment. But to ask Bartholomew to cover these topics as well would be asking him to write a second book—which indeed we must hope he does.

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The Conservation Scene

Conservation for the Twenty-First Century. DAVID WESTERN and MARY C. PEARL, Eds. Oxford University Press, New York, 1989. xxvi, 365 pp., illus. $36.95. Based on a conference, New York, Oct. 1986.

Extinction is a natural process. Millions of species have become extinct. Why, then, are conservation biologists so worried about current extinction rates?

First, estimates of current extinction rates are hundreds, possibly thousands, of times higher than the "background" rate of about one species per year over the past 600 million years. Second, many past species became extinct by evolving into new species—today, species are ceasing to exist without leaving descendants. Third, the present extinction crisis extends to most major categories of species, including terrestrial plants, which escaped relatively unharmed through many past mass-extinction episodes. Finally, human activities are undeniably the cause of most current extinctions.

Growing awareness of and concern about these facts among scientists have led to the emerging discipline of conservation biology and a plethora of conferences and books devoted to conservation biology, biodiversity, endangered species, and tropical rainforests. *Conservation for the Twenty-First Century* is the result of one such conference organized by Wildlife Conservation International, part of the New York Zoological Society. Focusing on wildlife, the conference drew together an unusually wide range of participants—scientists, planners, managers, philosophers, media representatives, lawyers, government employees, and representatives of national and international nongovernmental organizations from around the world. Their goals were to review the diversity of approaches to conserving nature, to assess the prospects for wildlife and habitat, and to identify the approaches and techniques that will be required for wildlife conservation through the coming century.

Because of this breadth, the volume would be a good choice for any scientist wanting an introduction to the conservation scene in the final decade of the 20th century—the magnitude of the problems, the scientific controversies, the organizations, and the literature. Although the book contains contributions from such stalwarts of the conservation biology movement as Diamond, Ehrenfeld, Eisenberg, Hales, Harris, Myers, Soulé, and Wilson, it is not limited to biology. After all, humans are the problem, and biologists are not experts on ways to change human behavior. As Western and several other contributors stress, conservation is linked to improving human welfare, especially in the tropics.

Many of the most biological chapters show that research relevant to wildlife conservation, contrary to the views of some in academia, can be good science as well. For example, Olson summarizes studies of fossil birds on oceanic islands, which demonstrate the shocking number of bird species that became extinct as a result of human colonizations. In the Hawaiian Islands alone, prehistoric anthropogenic extinctions were extensive, amounting to 50 species, nearly 51% of the native land birds. An additional 17 species of birds have become extinct in the historic period. Thus 69% of Hawaiian birds have become extinct since human colonization of the islands—and most of the remaining species are endangered.

Vrijenhoek, in a chapter on population genetics and conservation, summarizes his studies of genetic diversity and fitness in topminnows, genus *Poeciliopsis*. Closely related sexual and asexual forms coexist in the same desert springs. The sexual, but not the asexual, forms lose heterozygosity after drought-related reductions in population size. The demonstration that this loss of heterozygosity results in reduced developmental stability, reduced resistance to anoxic stress, and reduced competitive ability not only is of fundamental scientific interest but has resulted in improved recovery plans for several endangered topminnows. Unfortunately, as Vrijenhoek points out, there have been genetic studies of only a few endangered species. One problem is the difficulty of funding such studies. As he puts it (p. 89), "Genetic research is costly, and most of our time is spent in more fundable studies, involving economically or medically important species, or on basic research that attacks currently popular theories."

Woodruff's chapter, "The problems of conserving genes and species," underscores the challenge facing conservation biologists in this regard. Woodruff estimates that, if sound conservation is based on knowledge of the genetics, ecology, and behavior of a species, then we now have the scientific knowledge to manage about 100 species. He predicts that about 10,000 species will need such management by 2100.

Species can be managed wherever they occur naturally, in parks or nature reserves, or in zoos and botanical gardens. Conway has estimated that the cost of species conservation goes up from 10- to 10,000-fold at each of these progressively more intensive levels of management. Walker (p. 130) urges that "conservationists should spend less time worrying about the persistence of particular plant or animal species and begin to think instead about maintaining the nature and diversity of the ecosystem processes." This is no doubt the most sensible and cost-effective approach. But are we to abandon species, such as the California condor (*Gymnogyps californianus*) and the black-footed ferret (*Mustela nigripes*), that are in such critical condition that they can only be saved by captive breeding and intensive management?

The final chapter of the book, "An agenda for conservation action," identifies many areas in which research is needed. Those seeking inspiration for a thesis topic or new research project should also consult the report of an NSF-sponsored workshop organized by the Society for Conservation Biology published under the title *Research Priorities in Conservation Biology* (Island Press, Covelo, CA, 1989).

Although crystal balls are always murky, and the contributors to this volume foresee a variety of futures, all agree that the human population will continue to grow and that pressures on wildlife and habitat will increase. The nature of the world in 2100 will depend on decisions made today. Keystone people, as well as a better understanding of keystone species, will be required if wildlife is to be a part of that 21st-century world. The editors obviously hope that their book will reach some keystone people. Me too.

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