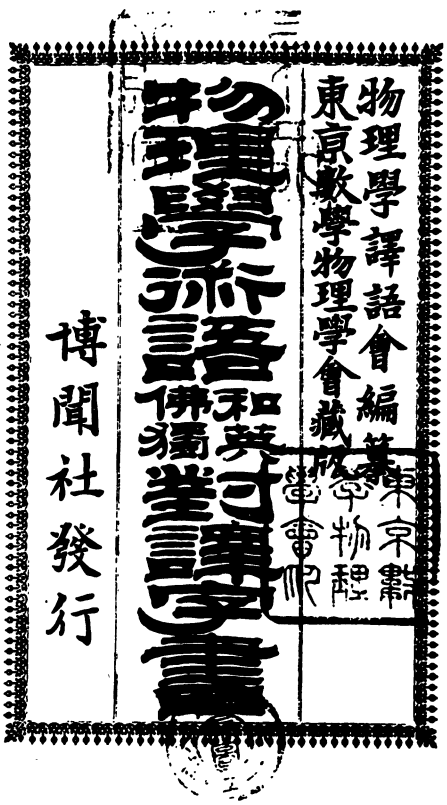
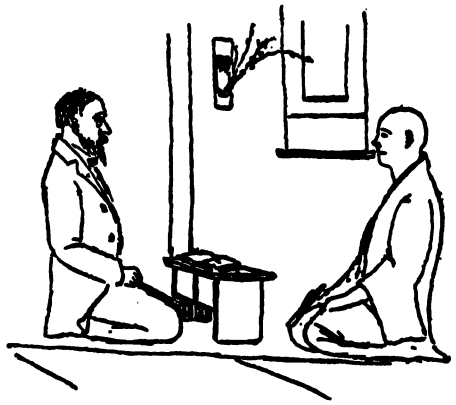
medieval Western philosophers; rather, they imagined the human world as residing harmoniously between heaven and earth, an arrangement Watanabe compares (pp. 103–105) to *ikebana* (traditional flower arrangement). The Japanese viewed nature "through the eyes of a poet" as opposed to the "Western conception, in which nature . . . is . . . an object of scientific research and an instrument to be used" (p. 4). Because of these divergent philosophical and cultural traditions, the transfer of Western science to Japan was inherently problematic, Watanabe writes. That is, in adopting Western science the Japanese either ignored the historic context of its development in the West or, if they did acknowledge that context, accepted it as normative and disregarded the different culture of Japan. Watanabe states that contemporary Japanese scientists in America claim that "traditional Japanese attitudes" have made it impossible for them to "make a creative contribution to the development of modern science" (p. 109).

While many Japanese scientists in the post–World War II era have indeed found American universities and labs more generous with resources and more conducive to research, their disillusionment with "traditional" attitudes has less to do with philosophies of nature than with concerns about old-boy favoritism or other such problems. (For an excellent study of the institutional development of science in Japan, see James R. Bartholomew, *The Formation of Science in Japan*, Yale University Press, 1989.) Watanabe's generalized and stereotypic notions of the philosophy and culture of both Japan and the "West" assume greater uniformity among the Euro-American nations and greater difference between Japan and the West than are warranted. He is far more convincing in his discussion of the negative effects of public policy on the advancement of science in Japan. Three examples will suffice. Watanabe cites an early (1876) physics professor who argued that the purpose of science was to serve the state, and since women could best serve the state by fulfilling their duty as mothers they should not be permitted to do science. Elsewhere, Watanabe strongly criticizes current methods of teaching science in Japanese schools, where students are crammed with facts they must recall for intensive exams. And he condemns the publicly accepted directions of scientific and technological "advances" for their despoiling of the beauty of nature.



The Japanese *Dictionary of Physics Terminology, Japanese, English, French and German* compiled by Yamagawa Kenjirō and others in the 1880s. "In a country like Japan needing to overcome in the shortest possible time a major lead by the West" the compilation of such a dictionary was "a particularly important task." [From *The Japanese and Western Science*]



Edward S. Morse learning Nō songs. Morse "is probably the first foreigner to have studied Japanese Nō-chants with a professional—in this case, Umewaka Minoru." [Reproduced in *The Japanese and Western Science* from Morse's *Japan Day by Day* (1917)]

The book's most interesting sections deal with Japan's adoption of Darwinian ideas. American zoologist Edward S. Morse arrived in Japan in 1877 to study brachiopods and soon began giving lectures on American debates about evolution. Although Darwinism was attacked by many Christians in the West, it could only have developed, Watanabe writes, in a Judeo-Christian religio-philosophical context. Yet it was widely accepted in Japan, a non–Judeo-Christian country, because it gave a "scientific"—and therefore unassailably modern—justification for Japan's late-19th-century rush to build national military and economic strength. In contrast to the situation in Europe and America, where scientists and theologians focused their debate on the common origins of humans and other animals, in Japan social scientists and humanists focused their debate on the issues of natural selection and the struggle for survival. Indeed, social scientific articles applying the theory of evolution were more common than natural scientific ones in Japan in the 1880s. Darwinism was viewed by many in the 1880s as an "eternal and unchangeable natural law" (p. 74) whose corollaries included militaristic nationalism in order to succeed in the struggle for survival and rejection of the contemporary movement for natural rights for the masses of average Japanese in favor of dominance by the supposedly superior few. Because of these undemocratic applications, Watanabe writes, the adoption of Darwinism left a problematic legacy.

Although this book's analysis of the philosophical and cultural dimensions of the development of science is not convincing, its discussion of the real difficulties faced in the transmission of science is quite cogent. Watanabe's warnings about Japan's uncritical acceptance of Western science is persuasive in light of the fate of Darwinism in Japan. Readers interested in the transmission of Western sciences to non-Western countries would find this book informative.

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Approaches to Systematics

Principles of Systematic Zoology. ERNST MAYR and PETER D. ASHLOCK. Second edition. McGraw-Hill, New York, 1991. xx, 475 pp., illus. $39.95.

These are exciting times in systematics. Spectacular new organisms and faunas in the deep sea, rainforest canopies, and ancient rocks continue to be discovered; the global "biodiversity crisis" demands baseline systematic inventory; developments in systematic theory, data acquisition, and analysis are fast breaking; a new society and journals have been founded to serve as forums for the ensuing discussion. The task of synthesizing such a rapidly moving and diverse discipline is challenging indeed.

The second edition of *Principles of Systematic Zoology*, by Ernst Mayr and Peter Ashlock, offers an overview of this field from the perspective of senior scientists who have

devoted their professional lives to its advancement. Mayr is an ornithologist who has contributed monumentally to systematics; he is known to all biologists for his work on the biological species concept. An eminent entomologist and theoretician of systematics, Ashlock died before the book was completed.

This is not intended as a "recipe" book on taxonomic methods, but several sections will be of interest to readers in search of practical advice. Chapter 11, on numerical phenetic and phylogenetic methods, will be very useful for beginners. We especially like the approach of providing a simple sample data set for readers to work with by hand. This should do much to dispel the mystique that computer analysis somehow bestows data (and results!) with emergent qualities. Also extremely useful is the chapter on the publication of systematic work; it should be read by every graduate student of systematics. Not for the beginner, however, is the chapter on nomenclature, which is mostly a critical commentary. Those looking for an entry guide to the International Code of Nomenclature would do better with a copy of the 1985 third edition of the Rules plus chapter 12 of the 1969 edition of *Principles of Systematic Zoology*.

The updating of the 1969 edition (which was authored by Mayr alone) has not been thorough. In several places, the latest references to areas within systematics that are advancing rapidly are 15 or 20 years old. The treatments of such important topics as phenetics, vicariance biogeography, character polarity, morphometrics (including allometry), numerical methods in microtaxonomy, and molecular techniques are incomplete and dated. For example, we think it a disservice to claim that the 1960 *Quantitative Zoology*, by Simpson, Roe, and Lewontin, is still "the best for the everyday needs of the animal taxonomist." *Quantitative Zoology* remains a useful book, but recent statistical texts, computer manuals for statistical packages, and a rich primary literature are in ample supply. The new edition of *Principles of Systematic Zoology* would have benefited from careful editing of the figures and tables for clarity and relevance. Readers will be annoyed, for example, to discover that sources of several figures are cited incompletely or are not included in the bibliography.

Mayr and Ashlock's seasoned perspective provides valuable insight on the school of biological classification known as "evolutionary systematics." According to Mayr and Ashlock, evolutionary systematists begin by grouping organisms on the basis of overall similarity. Cladistic principles are then used to test the provisional groups to identify and correct any that may be polyphyletic. Hierarchical rank of the resulting taxa is determined by consideration of genealogical relationships, within-group homogeneity of characters, and between-group character gaps. Special consideration is given to complex features related to "adaptive zones" and, insofar as possible, stability of traditional classifications. Mayr and Ashlock's "evolutionary systematics" thus combines the best of phenetics and cladistics to produce informative and stable classifications that are genealogical while also reflecting phenetic and ecological differences among taxa.

Mayr and Ashlock's new edition emphasizes classification as the most important product of systematic research. In fact, much of the section on macrotaxonomy is devoted to rehashing the differences of opinion about classification that have filled many pages in *Systematic Zoology* and other journals since 1960. Certainly all systematists agree that classification is essential, and much practical progress has been made even as the ideal nature and content of classification have been passionately debated. We believe, however, that the book's heavy focus on classification is misplaced. Partly as a result of this emphasis, the book fails to convey the intellectual excitement that characterizes other areas of systematic biology today. There have been unprecedented advances in practice and theory, particularly in the area of phylogenetics. Systematists have shown that genealogies are utterly essential for investigating adaptation, speciation, coevolution, evolutionary rates, macroevolution, and historical biogeography. Increasingly, phylogenetic thinking and systematic research are attracting the attention and participation of ecologists, behaviorists, functional morphologists, and molecular and developmental biologists. There is a promising future for phylogenetic systematics in interdisciplinary research. At society meetings and in our classrooms, we see a new generation of bright graduate students, including many from biological disciplines beyond taxonomy per se, who are actively seeking training in phylogenetic systematics. Mayr and Ashlock's book will teach these students where systematics has been, but they will have to seek information and inspiration elsewhere as they prepare to take systematics into the 21st century.

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Beneath the Continents

Continental Mantle. MARTIN A. MENZIES, Ed. Clarendon (Oxford University Press), New York, 1990. xiv, 184 pp., illus. $98. Oxford Monographs on Geology and Geophysics, 16.

Even those who study the continents sometimes forget that the continental plate consists predominantly of mantle. Though most of our knowledge of continents has and continues to come from the crust, the importance of the mantle has become apparent with the advent of plate tectonics. Understanding the forces that have formed and deformed the continental plate clearly requires knowledge of the mantle component. To the extent that the crust and mantle are complementary geochemical reservoirs, the continental mantle provides an important clue to the differentiation processes that formed the crust. In the earth sciences, we now stand a quarter-century into the plate-tectonic revolution, and one of our most important jobs is to utilize plate tectonics to unravel the earth's history as revealed in the continental crust and mantle. More than anything else, this book serves to give the continental mantle the thorough examination it deserves. In addition it makes the point (chapter 1) that the continents must be understood in the context of the entire mantle. This broadening of scope is essential and has been motivated by plate tectonics, the recent tomographic images of a convecting mantle, and the realization that the continents have responded over time to this convective system.

As with the continental crust, the study of the continental mantle involves a variety of subdisciplines in the earth sciences. The strength of this book is that it provides a thorough discussion of the most important current observational constraints from geophysics (especially seismology), petrology, geology, and various branches of geochemistry (geochronology, stable isotopes, fluids, and redox-oxidation equilibrium studies). In addition, it provides a fairly good historical perspective of two of these areas, seismology and petrology. Conspicuous in its absence, however, is any discussion of continental dynamics from a theoretical or numerical-modeling perspective. Such a chapter would have complemented nicely the observational emphasis.

Although each chapter was written independently, usually by a different author, there are several recurring themes in the book. The most important of these concerns the contrasting nature of the lithospheric mantle beneath various geologic provinces. In most early plate-tectonic models, the crust was regarded as the sole distinguishing