The Unfolding of a Philosophy

The Magic of Numbers and Motion. The Scientific Career of René Descartes. WILLIAM R. SHEA. Science History Publications (Watson), Canton, MA, 1991. xii, 371 pp., illus. $54.95.

René Descartes (1596–1650), the younger contemporary of Kepler, Galileo, and Harvey, played a pivotal role in the unfolding of the Scientific Revolution. When he began his scientific studies in 1618, the Copernican theory was being widely adopted by advanced thinkers, mathematics and the mathematical sciences were rapidly extending their domain, and the experimental and observational sciences were revealing unexpected worlds. Aristotelian philosophy had been under attack from various quarters—neo-Platonists, alchemists, magicians, and natural philosophers—for over a century and was now generally perceived as an inadequate foundation for the new worldview.

Descartes provided a new foundation for the new science. The fundamental idea, that all natural phenomena were to be explained solely by matter and motion, soon became known as the mechanical philosophy. Spirits, souls, desires, and Aristotelian forms were banished from matter, and all change was attributed to contact action. The principal new direction for science became the explanation of macroscopic phenomena by the mechanical properties of invisible corpuscles. Few phenomena escaped the scope of Descartes's program: the motion of the heavens was explained by vortices of aetherial corpuscles, magnetism by screw-shaped particles and pores, and the circulation of the blood by a heart that operated like a steam engine. Though other contemporaries, such as Thomas Hobbes and Pierre Gassendi, proposed similar ideas, Descartes's exposition of the mechanical philosophy in his *Principles of Philosophy* (1644) was so bold, comprehensive, and full of promise that it was at the center of natural philosophy for the next half-century. At a more mundane level, Descartes made many contributions to specific sciences. He began analytic geometry (whence our Cartesian coordinates), discovered the long sought-after law of refraction, and explained the formation of the two rainbows in his *Geometry*, *Dioptrics*, and *Meteorology*, which were published together with his *Discourse on Method* in 1637.

Descartes was not offering just another hypothesis or explanatory scheme to account for the natural world but a philosophy based on certain metaphysical principles. His starting point was one of complete doubt, although he soon concluded that he could nonetheless not doubt that *cogito, ergo sum* (I think, therefore I am). Thus mind must exist. He then argued that because God would not deceive us, and he (Descartes) has a clear and distinct idea of a qualityless matter whose sole property is extension in space, then this matter too must exist. The world therefore consists of two distinct entities, mind or thinking substance and extended matter. This is the metaphysics of a Catholic mathematician. Just as Descartes's science opened a new era, so his metaphysics is at the foundation of modern philosophy.

Granted Descartes's significance in the development of modern thought, it is surprising that there exits no book in English that presents a comprehensive account of the development of his science and its relation to his philosophy. J. F. Scott's *The Scientific Work of René Descartes* is useful, but it is really only a précis of Descartes's published works. William R. Shea's handsomely produced *The Magic of Numbers and Motion* now attempts with varying success to fill this lacuna. Shea combines a thematic approach, focusing a number of chapters on particular scientific breakthroughs in mathematics, optics, and mechanics, with a chronological one—beginning with Descartes's Jesuit education, then following him through his earliest scientific work with the remarkable Dutch schoolmaster Isaac Beeckman and thence to the forging of his mature views in the next two decades. Though the main line of the story is based upon Descartes's published works, Shea skillfully interweaves Descartes's large and illuminating correspondence into the narrative.

The most interesting parts of the book are the opening chapters devoted to Descartes's earliest, and least known, scientific ventures. Shea's account of Descartes's investigations of free fall, hydrostatics, harmonics, and the description of mathematical curves serves to bring out a number of important points: the role of Isaac Beeckman in stimulating his research; the central role of mathematics in his thinking; and the long path that lay ahead of him in formulating his version of the mechanical philosophy. Throughout Shea also brings out the importance of Descartes's Roman Catholic religion in his life and thought.

Shea succeeds in depicting Descartes's self-confident and arrogant personality and elusive style as revealed through his numerous exchanges with other natural philosophers. It is too easy, however, to focus on the contradictions and difficulties in Descartes's views and his evasive, enigmatic defenses of them. All too often, Descartes's difficulties in his mature views indicate profound issues lurking beneath the surface, and Shea does not sufficiently probe those depths. Indeed, one finishes the book wondering why Descartes was so influential or why, for example, Huygens and Newton had begun their scientific careers by assiduously studying all of his writings.

This raises the question of the intended audience for *The Magic of Numbers and Motion*. Those knowledgeable of the period of Descartes will often find that the depth and subtlety of his thought are not adequately rendered. Those turning to the book for an introduction to Descartes's scientific thought will often find that insufficient historical background is provided to appreciate his significance. A more complete synthesis of the large literature on Descartes and the Scientific Revolution is required in order to more thoroughly fill a major gap on one of the central figures of that Revolution.

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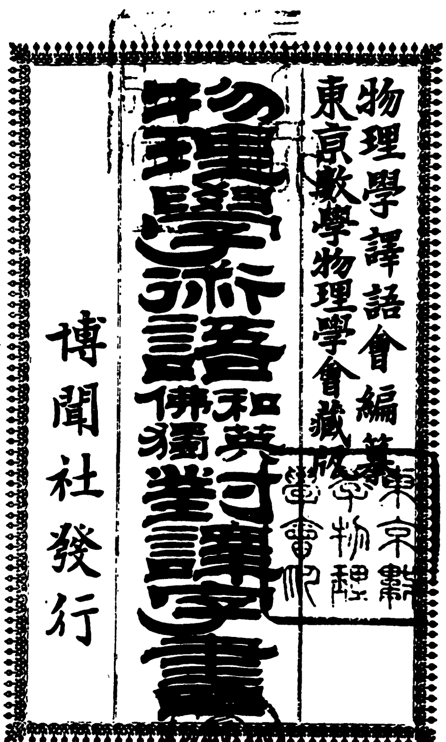
A Cultural Transplant

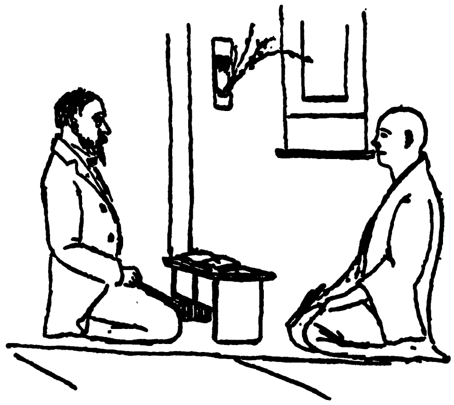
The Japanese and Western Science. MASAO WATANABE. University of Pennsylvania Press, Philadelphia, 1991. xiv, 141 pp., illus. $28.95. Translated from the Japanese edition (Tokyo, 1976) by Otto Theodor Benfey.

This slim volume by a leading Japanese historian of science argues that the Japanese have been culturally ill-adapted to do "Western" science since its introduction in the 19th century. The author says this is because Japanese philosophers never viewed the human world as the center of the universe and in conflict with the divine world, as did 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



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)]

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 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