Book Reviews

Timekeeping and Culture

Revolution in Time. Clocks and the Making of the Modern World. DAVID S. LANDES. Belknap (Harvard University Press), Cambridge, Mass., 1983. xx, 482 pp. + plates. $20.

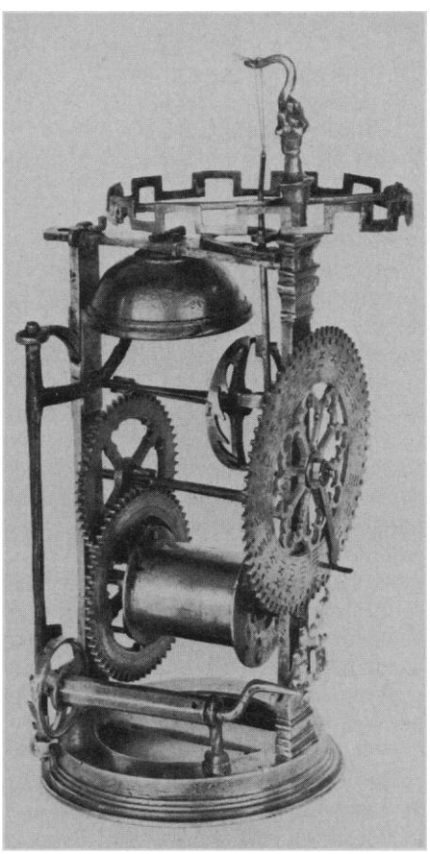
In the last half of the 13th century, though no one knows precisely when or where, there appeared in Europe a new and revolutionary device—the mechanical clock. This machine was weight-driven, transmitted the energy of the falling weight via a gear train, and relied for a measuring mechanism on what David Landes terms "the Great Invention: the use of oscillatory (continuous back-and-forth, to-and-fro) motion to track the flow of time" (pp. 7–8). It was to have an enormous impact on life in the West, far exceeding the influence of earlier means of indicating the time such as sundials, sand clocks, and water clocks. Landes cites and follows the well-known view of Lewis Mumford's *Technics and Civilization* that the clock was "the key-machine of the modern industrial age . . . the foremost machine in modern technics." *Revolution in Time* is something of an intellectual tour de force, which its author describes as "a triptych: a study in cultural history (why was the mechanical clock invented in Europe?); in the history of science and technology (how did we get from crude, approximate timekeepers to instruments of high precision?); and in social and economic history (who made these instruments? how? who used them? why?)" (p. xv). It is a delightful and important book, of a scope and kind that only a few historians could write. It is also highly uneven and somewhat less original than it purports to be.

Landes engages here many of the same problems addressed in Carlo Cipolla's 1967 book, *Clocks and Culture, 1300–1700*. Both historians wrestle with the question of why the mechanical clock became central to European and not to Chinese civilization. Like Cipolla, Landes argues that the differing cultural contexts, different attitudes and values, made clocks much more pertinent to European civilization than to Chinese: "It was simply not important in China to know the time with any precision" (p. 44).

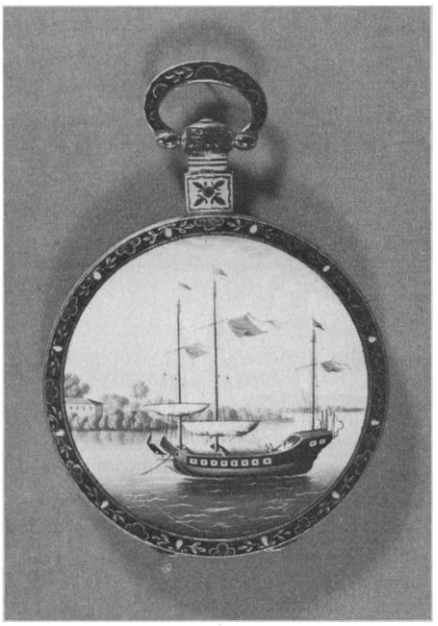
Landes wisely shuns the problem of analyzing the process of invention, in which accident customarily figures so heavily. Instead he concentrates on what Joseph Schumpeter termed innovation, the process by which some new devices spread and have a wide impact on society. Because he is an economic historian, Landes sees this question as one of demand, of markets for the new mechanical clock. The Chinese had no significant market, though they clearly had invented a form of the device as early as the 11th century. European life, however, provided several sources of demand. First and most important was the monastic clergy, who lived by "the temporal discipline of the cloister" (p. 69). Other significant markets included "the numerous courts—royal, princely, ducal, and episcopal; and . . . the rapidly growing urban centers with their active, ambitious bourgeois patriciates" (p. 70). From these beginnings modern Western civilization—rational, scientific, capitalistic—manifested stronger and stronger demand for mechanical clocks, for greater numbers of clocks and clocks of ever greater precision. In navigation, commerce, sports, science, manufactures, and the daily lives of almost all citizens, the influence of time, punctuality, and precision grew. Those portions of the book dealing with the cultural impact of precision timekeeping in the West are excellent, learned, and conveyed in superb prose. If they owe perhaps more than is indicated to the work of Cipolla, Mumford, and E. P. Thompson, we can agree with Landes that "in matters of self-appraisal, it is human to err on the up side" (p. 30).

The second and third parts of the triptych—an exploration of technical advances in mechanical clocks and the story of their manufacture and marketing in the West—display the same wide learning and lucid prose as the first. *Revolution in Time* struggles manfully with the task of explaining technical changes, but Landes (as I suspect most readers will) often tires of the detail and moves back to the larger picture. It must be noted that the task of understanding the technology of clocks in this book would have been vastly easier if the Harvard University Press had done a better job of design and layout. The numerous illustrations are segregated into three widely separated sections that make it very difficult indeed to study the relevant pictures and prose together, which is necessary if one is to understand such technical material. In this respect the author was poorly served by his publisher.

When Landes turns his hand to telling the story of the business and economic history of the clock and watch industries over several centuries, we see a master at work. Here in tone and topics this



"Verge and balance-wheel alarm clock, c. 1450. There are two trains: a going train for timekeeping (verge and crown wheel, or scape wheel, behind the twenty-four-hour dial); and an alarm train (verge at far left, crown wheel at lower left, bell at top, below balance wheel). The clock is bereft of cords and weights. Though dated from the fifteenth century, it is thought that similar clocks were built one hundred and more years earlier; and that the alarm train, with hammer working off the verge, may have been the inspiration for the going train of the mechanical clock." [Reproduced in *Revolution in Time* from E. L. Edwardes, *Weight-driven Chamber Clocks of the Middle Ages and Renaissance*, Sherratt, Altrincham, England, 1965]



"An expensive Fleurier watch for the China trade, c. 1830. Signed 'Tevob,' which is Bovet spelled backward. The Bovets of Fleurier were the leading merchants in the export of Swiss watches to China in the second quarter of the century, drawing their stock from *établisseurs* who organized production in Fleurier and the surrounding area. Why they signed some of their pieces 'Tevob' is hard to say. These were not a second-quality line. The above has an elegant polychrome enamel painting of a Chinese water scene—this at a time when Chinese painters were busily decorating porcelain with analogous scenes of European life for export to the West. Such watches were usually fitted with jump center-second hands and highly engraved, eccentrically shaped bridges to suit what was perceived to be the Chinese taste." [From *Revolution in Time*; Collection of the Musée d'Art et d'Histoire, Geneva]

book has much in common with Landes's superb 1969 study of technical change and industrial development in Western Europe since 1750, *The Unbound Prometheus*. Although clocks and watches figured hardly at all in that study, here they are the most important technology of industrial civilization. Now it appears that "no other branch of production has done so much . . . to teach others the use of tools and machines and the advantages of division of labor" (p. 13). The cause of this dramatic shift in the author's assessment of the importance of timekeeping technology and manufacture is not clear, and one wonders why that question is not addressed more directly.

Revolution in Time returns at its conclusion to an Asian topic—the Japanese triumph in the recent and revolutionary technology of quartz watches, ending a centuries-long Western (especially Swiss) dominance of the market. The book closes abruptly, without returning to the themes of cultural influences on economic and technological history. This is puzzling, because Landes uses his cultural model to account at various times for the preeminence of French-speaking Swiss, of English, and of American competitors in the timekeeping industry. Even more puzzling is the fact that, unlike Cipolla's *Clocks and Culture*, this book takes no note of the Japanese adoption of clock technology in the early era of European manufacture of the mechanical clock, a time when the Chinese regarded it purely as a toy.

The cultural explanation of technological and economic change, though powerful and useful, is a crude and limited device. It is clearly helpful in understanding why China did not lead the world into the industrial era, but it is much less satisfying when used to explain differences in the economic performance of essentially similar cultures (such as those of 19th-century Britain, Switzerland, and the United States). Cipolla's more restrained and consistent use of this kind of cultural analysis may be sounder.

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Influenza Viruses

The Origin of Pandemic Influenza Viruses. W. G. LAVER, Ed. Elsevier, New York, 1983. xvi, 309 pp., illus. $59.50. From a workshop, Beijing, Nov. 1982.

Periodic antigenic shifts of influenza A viruses have resulted in worldwide epidemics or pandemics. The names of these viruses are household words: the swine flu of 1918, the Asian flu of 1957, the Hong Kong flu of 1968, and, more recently, the Russian flu of 1978. Antigenic shifts associated with these pandemic strains have occurred in both of the major surface structures, the hemagglutinin and the neuraminidase, or in only the hemagglutinin. The antigenic change makes it possible for a virus of epidemic potential to circumvent the accumulated influenza antibody in the population and spread rapidly throughout the world.

How and exactly when these shifts occur has been the subject of speculation for many years. According to influenza folklore, pandemic viruses originate in China. The inaccessibility of the People's Republic of China during the 1957 and the 1968 pandemics and the absence of any information from that area heightened the mystery and fueled speculation about the origin of these viruses. It is only fitting that the workshop that is the basis of this book was held in Beijing.

The proceedings cover a wide range of topics including the structure and antigenicity of the hemagglutinin and the neuraminidase, gene expression and virus multiplication, immune responses, influenza viruses from birds and lower mammals, and control of influenza. Over half of the proceedings is devoted to molecular biology, and rightly so. Answers to the puzzle of antigenic shift and drift (the phenomenon of gradual changes in the surface antigens during interpandemic periods of virus prevalence) ultimately lie in our understanding of the structure, composition, and function of the virus. This workshop serves to confirm and expand the rapidly accumulating information on the surface structure. It is now generally accepted that there are four principal regions on the hemagglutinin that interact with antibodies and undergo amino acid alterations during periods of antigenic modifications; that a single amino acid substitution in the appropriate location can alter antigenicity; and that carbohydrates of the glycoprotein can affect immune recognition, presumably by steric interference. These findings have made possible a more precise definition of pandemic viruses and a better understanding of drift and shift. They also explain many of the seemingly bizarre antigenic relationships between viruses.

Data from this workshop provide continued support for the hypothesis that the pandemic virus, with its abrupt and extensive changes in amino acid composition of the hemagglutinin, is a major genetic, as well as epidemiologic, event. The most common explanation, at least for the viruses that caused the 1957 and 1968 pandemics, is that the "new" virus arises through the exchange of gene segments with influenza A viruses of animals. Viruses antigenically related to known human viruses have been isolated from time to time from the gene pool in domestic ducks and pigs in China. The significance of animals as reservoirs of prospective human viruses has been considered for years. Influenza viruses affect animals such as horses, pigs, and many avian species. This book focuses on the relationships between humans and domestic animals known to be infected with influenza viruses. Of particu-