

BOOK REVIEWS

History can often be usefully illuminated by studying the development of a particular concept, in both its theoretical and practical forms. David Landes is not the first scholar to use the measurement of time as his angle of entry into world history. Not that his book attempts to deal with the whole of this enormous subject: His concern is essentially with the invention and improvement of mechanical clocks. But he necessarily touches upon much wider aspects of time-measurement which raise fundamental questions about human societies, and it is therefore a pity that his book is not better organized. He begins with a long section on the huge water-clocks, or clepsydras, which the Chinese built in the early Middle Ages for astronomical purposes. He asks why these marvels proved a dead end, from a technological viewpoint, and answers that it was a mixture of bureaucracy, state control of invention, and the lack of a commercial use for accurate chronology. Then he moves on to the use of clocks in medieval Europe.

It would have been more logical to start with the ancient Egyptians, who in their muddled pragmatic way were the real innovators in time-measurement. They developed both the clepsydra and the gnomon, or sun-clock, around the middle of the second millennium B.C., and examples of both can be seen in the British Museum. The Oriental Institute in Chicago also has part of an ebony bar which probably belonged to a machine for charting the stars and dates from not much later. Egyptian night star-clocks, examples of which were often painted onto the ceilings of tombs, became the basis of the 24-hour system, which was then calibrated on the clepsydras and gnomons. When the Greeks built Alexandria, they adopted the 24-hour system and the corresponding 365-day year, and it was the Alexandrian astronomer Sosigenes who later produced the standard "Julian" calendar for Caesar—in use, with modifications, throughout the world today.

Why did the Egyptians not push their technology further? Probably because chronometry was an arcane monopoly of the priests; it was something confined to the hieratic script and excluded from the demotic of the trading community. Yet there may be a connection between Egypt

Paul Johnson's most recent book is *Modern Times* (Harper & Row).

REVOLUTION IN TIME: CLOCKS AND THE MAKING OF THE MODERN WORLD

David S. Landes/Harvard University Press/\$20.00

Paul Johnson

and later Western technology. Landes rightly points to the critical part played by Latin monasteries in the strict enforcement of daily time-divisions, both for prayer and work, and so in the emergence of clocks. The notion of clerical communal farms originated in Egypt, where they took the form of perpetual funerary temples, operating to precise prayer-schedules and probably work-practices too. The first Christian monks came from this region, and when the movement spread to Italy it was galvanized and regulated by the great rule of St. Benedict, the basis for all subsequent monastic routines. In contrast to monks of the Eastern Orthodox rite, who were often ideorythmic, each determining his own prayer-and-work timetable, the Benedictines were made to follow strict communal schedules both for purposes of moral discipline and to enable their farms to pay. Convinced that idleness led straight to hell, and obsessed by the need to employ

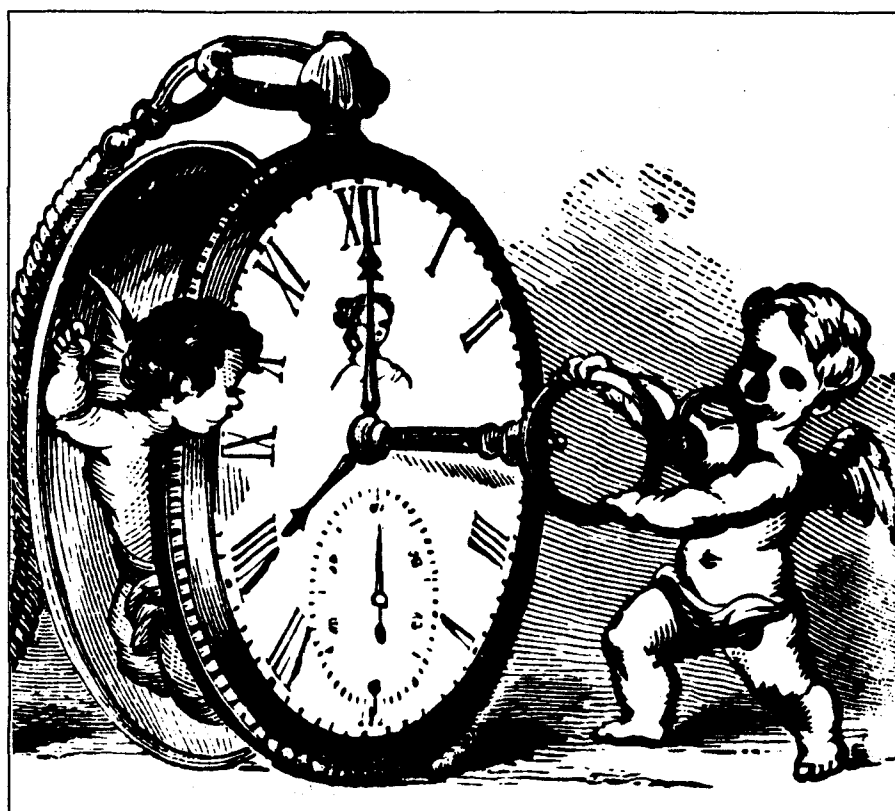
time in God's service, St. Benedict was the ultimate progenitor of modern capitalism. Certainly the Benedictines were the first to develop reliable water-clocks in the West, and the Cistercians, who evolved from the Benedictine order about 1100 and rapidly became the most successful agricultural innovators in Europe, ruthlessly exploited the advantages of strict timekeeping in raising the productivity of large work forces.

Almost inevitably, then, the first true mechanical clocks, which appeared in the thirteenth century, were made for ecclesiastical foundations. Landes is a bit vague about how and when they emerged. It is true that the earliest references do not clearly differentiate between water-clocks and mechanical ones powered by weights. But the evidence seems plain that they were first installed in cathedrals, which led almost all Western technologies at this time. Cathedrals had large clerical communities organized like monks (in-

deed in England half the cathedrals were monasteries) and they carried out elaborate daily timetables of services. The first clocks date from the 1280s, mainly in England, and it is no accident that the earliest to survive was installed in 1386 at Salisbury, famous for the strictness and regularity of its liturgy. It is an impressive, if cumbersome, piece of work, but nothing by comparison to the spectacular device installed six years later at Wells, probably by the same bishop. The Wells clock is the most elaborate piece of machinery to come down to us from the Middle Ages and includes not only a moon-clock but a mechanical giant called Jack Blandifer who strikes the hours by drumming his wooden heels on the bells. Blandifer is much better value than the famous crowing cock at Strasbourg Cathedral, though visitors ought to know that hardly any of his mechanism consists of the original parts.

Once Landes gets past the hurdle of the first mechanical clock, his narrative becomes more satisfactory, and the rest of his book is a vivid and fascinating summary of how these clocks were progressively perfected until the quartz revolution made the notion of mechanized timekeeping obsolescent. It is no accident, of course, that this technical progress moved *pari passu* with the emergence of industrial capitalism; no accident, either, that capitalism developed first in Christian Europe. For Christianity, unlike the cyclical religions of the Orient, is a linear time religion, moving historically from Creation to Last Judgment. So of course is Judaism, but Christianity has a much more emphatic eschatology which is central to its Creed (some of the most famous Jewish formulations do not include the Messiah-coming as an essential article of faith). So for Christianity, time is of the essence: "Thou knowest not the day nor the hour . . ." Time is capital given by God to every soul, to be well spent and returned to Him with interest at the final reckoning. The urge to calculate its passing was thus a strong one among Christians, and during the later Middle Ages a large proportion of the available technical skills and resources of Christendom was devoted to improving clockwork.

The first great advance came about 1400 with the creation of a workable spring-driven mechanism, a device whose effectiveness was enormously



increased by the introduction of the fusee-wheel thirty years later. The effect of this was to make possible the progress from what Landes calls "time obedience," the imposition of work hours by external authority, to "time discipline," the internal ordering by individuals of their own work lives. The earliest mechanical clocks, 1280-1400, were huge affairs, suitable only for public purposes in monasteries, cathedrals, and *hôtels de ville*. The spring and the fusee made it possible to miniaturize the mechanism and so to domesticate timekeeping. Thus we get the fifteenth-century house-clock and then, around 1500, the watch. The notion of personal time-thrift, made possible by portable clocks and watches, was probably much more important as a capitalist dynamic than the Calvinist "salvation panic," first identified by Max Weber. Indeed, time-thrift antedates Calvinism by a century. I have myself cited the Merchant of Prato's business philosophy as evidence that capitalism was a product of Latin Christianity rather than Calvinism specifically; and Landes caps this with a striking quotation from Alberti (1433): "In the morning when I get up, the first thing I do is think as though to myself: what am I going to do today? So many things: I count them, think about them, and to each I assign its time." The vital thing was "to watch the time and assign things by time, to devote oneself to business and never lose an hour of time. He who knows how not to waste time can do anything; and he who knows how to make use of time will be lord of whatever he wants."

Private time, the house-clock or personal watch, was linked to the private conscience, and this no doubt helps to explain why the time-dynamic of early capitalism was more common among Protestants. Of course the first such communities were usually found in towns, especially among prosperous craftsmen, and it explains the evidence Landes cites to show that clockmakers tended to be Protestants. This was still true in late seventeenth-century France, where Louis XIV's disastrous revocation of the Edict of Nantes in 1685 led to a mass emigration of clockmakers and so to the foundation of the Swiss watch industry. Landes, however, is too much of a Weberian for my taste. I take the view, first set out by Hugh Trevor-Roper in *Religion, the Reformation and Social Change* (1967), that the capitalist spirit was interdenominational and was strongest among emigrant communities of various types (including Catholics and Jews) forced to displace themselves by clericalism and state intolerance of all kinds. The common denominator was Erasmianism, a

stress on private religion, rather than Calvinism as such.

The drive for more accurate, reliable, and cheaper timepieces came from a variety of sources. One was the growing need, from the sixteenth century on, for accurate scheduling of long-distance coach services, which also meant coordinating absolute time in different big cities and even countries. So we get the coach-watch, which

developed into the traveling-clock, that marvel of eighteenth-century technology and elegance, still common today (though increasingly pricey). Again, field commanders of large armies had to devise strict timetables for moving them from A to B and deploying them in battle; and that meant officers must have reliable watches. Landes notes that among the first bulk purchasers of watches were generals,

and the mass production of cheap watches really dates from the American Civil War.

The biggest spur to accuracy, however, was the universal need of navigators to determine longitude, which demanded very accurate chronometry. The principle of the pendulum, conceived by Galileo in 1637 and realized by the Dutch craftsman Christian Huygens in 1656, and the ar-

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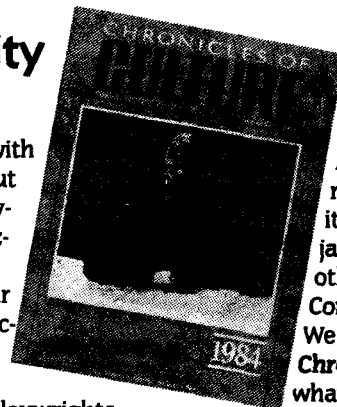
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NON-LIBERAL CRITICISM AT ITS BEST.

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rival of the balance- or hair-spring about 1675, did not produce the required degree of accuracy. In 1713 the British parliament passed an Act awarding the immense sum of £20,000 to anyone of whatever nationality who discovered the way to determine longitude within one degree. The problems were enormous and the prize was not won until 1761 when an autodidact from Hull, John Harrison, produced

what is known as his No. 4 Marine Timekeeper, now in the National Maritime Museum at Greenwich. Harrison could only have succeeded in a free enterprise society, such as Britain and Holland alone possessed at that time. But the episode also testifies to the altruism of creative capitalists—so foreign to the nonsensical abstraction of Marxist analysis—since it was the leading clockmaker of the day,

George Graham, who provided Harrison with the funds he needed to develop his invention, demanding neither security nor interest. Of course, without the intervention of the prize-awarding state in the first place, Harrison would have had less incentive; so all kinds of political theorists can draw comfort from the episode. But Landes points out that the bureaucrats did their best to deprive Harrison of his

well-earned prize and he got it in the end only because George III, an amateur clockmaker like his contemporary Louis XVI, intervened personally: "By God, Harrison, I'll see you righted!"

Harrison was probably the greatest clock-technician of all time, because after him there was nothing but refinement. I find moving the words with which he signaled the end of his quest: "I think I may make bold to say that there is neither any other Mechanical or Mathematical thing in the World that is more beautiful or curious in texture than this my watch or Timekeeper for the Longitude . . . and I heartily thank Almighty God that I have lived so long, as in some measure to complete it!"

After the conquest of the problem of longitude, the role of clockmaking on the frontiers of science inevitably declined, though the two remained connected. The quest for perfect accuracy in timekeeping inspired new technology, especially in lubricating oils, bearings, and the use of ultra-hard materials, and in turn precision in timekeeping made new technologies possible. But the second part of Landes's book is essentially the tale of commercial economics in the large-scale production of watches. The British, supreme in all branches of the market during the eighteenth century, showed an extraordinary unwillingness to adapt to changed conditions and were not helped by government tax policy. They retreated first to the luxury end of the market (always a bad sign), then yielded all to the Swiss.

The dominance of the Swiss in the manufacture of watches has been one of the most durable achievements in industrial history. It repays study by anyone interested in what should be the correct role of government in stimulating and safeguarding a key industry while still maintaining intense competition within it. The Swiss fought off two tremendous challenges from the United States, the first in the 1870s from the famous American Watch Company of Waltham, which began the mass production of quality watches, the second in the 1960s from that once-fabulous product, Timex. They did so by the well-tried method of investigating the competition, then doing it better.

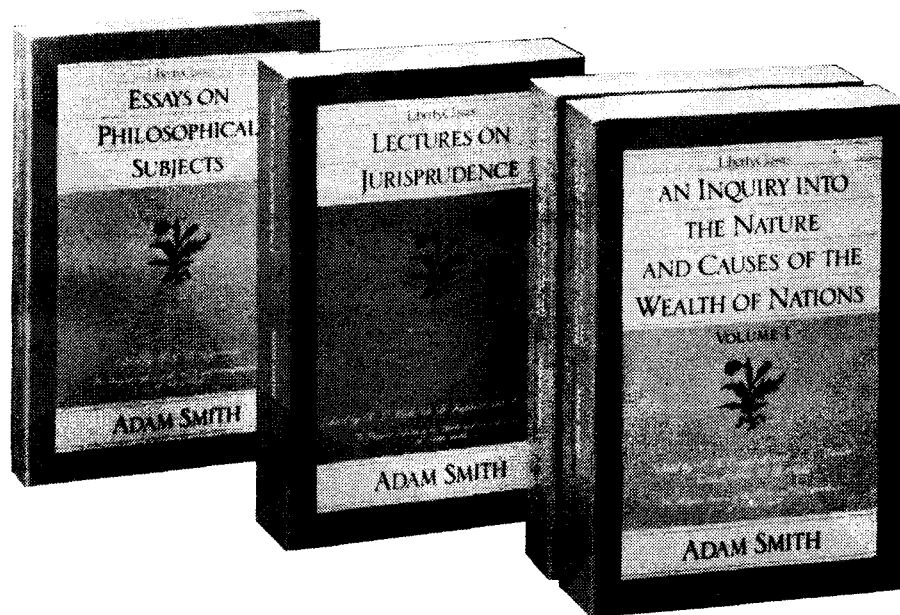
In the end, however, the Swiss like the British became a victim of their past: So miraculous was the technology of their mechanical movement that they simply would not accept it could be replaced by a totally different system. Around 1900 Pierre Curie had noticed that certain crystals, especially quartz, vibrated

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mechanically when electric current was passed through them. The vibrations were extraordinarily rapid and could be made stable, thus (in theory) ensuring an accuracy of beat unattainable by the balance-wheel and hairspring, however refined. An American firm made the first quartz clock in 1928, and one which tracked time within two-thousandths of a second per day was installed at Greenwich as long ago as 1939. But it took thirty years to miniaturize them to watch-size, and even then (1968), the first quartz watches cost over one thousand dollars. The Swiss thought they could ignore the challenge, though at their own central research laboratory in Neuchatel in 1967 a quartz marine chronometer achieved an accuracy score of 0.0099 (0 is theoretically perfection) against a mechanical record of 2.3. As with all great new technological advances, the refinements and cost reductions, when they came at last, arrived with devastating speed, leaving the Americans and Japanese in the van, and the Swiss (like the British before them) taking refuge in the upper end of the market.

But once a technology is outmoded, "quality" offers no hiding place. Landes writes:

Today it is possible to buy a solid-state watch for about \$100 that keeps better time than the finest detent pocket chronometer, repeats the minutes, sounds the hours, gives the day and date with due attention to the varying lengths of the months (including February in leap year), measures elapsed time to the tenth, even hundredth, of a second, serves as preset timer, and offers the possibility of setting several alarms to remind the wearer of a succession of engagements. A mechanical watch with such capability would not fit in an ordinary pocket, would weigh a pound, and would cost several hundreds of thousands of dollars—if one could find the workers to make it.

The Swiss are falling back, therefore, on nonfunctional snobbery, selling the watch "that tells you something about yourself" or "the most expensive watch in the world," or encrusting timepieces in diamonds. But of course there is no long-term future in that strategy, either, as the British also discovered. As Landes says, "It is hard to love a quartz timepiece," but once a mechanical watch has lost its claim to be the most accurate way of recording time, it ceases to be a true precision instrument and becomes a mere expensive toy, a pseudo-antique. There is nothing so remorseless as advancing technology, to whose verdicts there is no appeal on grounds of sentiment, beauty, or past record.

I wish Landes had given us a final chapter discussing the future of timekeeping as the experts now see it.

What is the present relationship of chronometry to astronomy, and is the ultimate timekeeper a truly scientific star-clock, thus bringing the wheel of progress full circle? But perhaps this

is to be ungrateful to Landes, who has written a highly original book which, for the general reader, opens new windows into the story of human progress. □

THE CONFIDENCE GAP: BUSINESS, LABOR, AND GOVERNMENT IN THE PUBLIC MIND

Seymour Martin Lipset and William Schneider/Free Press/\$19.95

A. Lawrence Chickering

At the end of the 1960s, conflict and polarization over race and the Vietnam war, among other issues, had reached the point where serious people routinely wondered whether America had become ungovernable. Then the war wound down, things started to improve, and most observers assumed the problems that seemed so extreme in the sixties were safely behind us.

At the end of the seventies, it was clear they were not. A sense of "malaise" continued to hang over American society—a malaise which President Carter, in a television address, warned was a "crisis of confidence" that took the form of "a growing disrespect for government and for churches and for schools, the news media and other institutions. . . ." The problem continues, and it reaches to the depths of the difficulties recent Presidents have had in gaining public support for their policies. For this reason, Seymour Lipset and William Schneider's *The Confidence Gap: Business, Labor, and Government in the Public Mind* presents a timely analysis, using all of the tools of social science at its best.

The book is divided into three parts. The first analyzes general patterns of confidence in institutions and reports the wealth of survey data showing that public confidence in all social institutions—including government, religion, labor unions, medicine, science, corporations, and related sub-categories—began to decline in the mid-1960s and continued to decline through the seventies and even into the early eighties. The second focuses specifically on attitudes toward business, labor, and government, and the social and political bases of those attitudes. And a final part tries to analyze causes, effects, and possible solutions.

A. Lawrence Chickering is Executive Director of the Institute for Contemporary Studies.

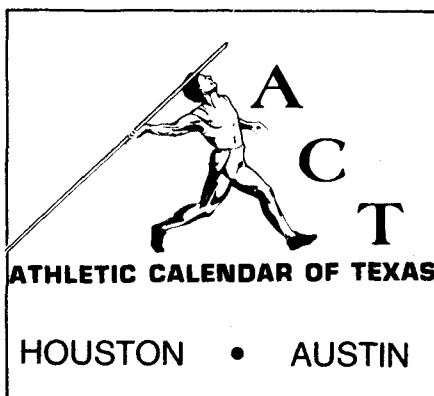
What is most striking about the masses of data in this book is the generality of the trends. For example, Harris polls taken between 1966 and 1981 show that the percentage of people expressing "a great deal of confidence" in the leaders of the executive branch of government declined from 41 percent in February 1966 to only 24 percent in September 1981. Confidence in congressional leaders declined in the same period from 42 to 16 percent; in leaders of major companies from 55 to 16; education, 61 to 34; and organized religion, 41 to 22. The consistency of the trends is especially evident in attitudes toward institutions that might seem mutually antagonistic, such as science and religion. Yet during this period attitudes toward these two institutions tended to rise and fall together. Average confidence in all institutions studied declined from 48 percent to 23 percent.

Although the general trend was down, there were variations. Some institutions (such as business) fell further than others (medicine). And the trend was not always down: The coming of a new President (Ford in 1974, Carter in 1977, and Reagan in 1981) brought a brief recovery each time. The

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sharpest decline occurred between 1966 and 1971—the period of the worst political and social problems. Average confidence during this time fell from 48 percent to 28.

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