Introduction

> I found I had been there a year, so I divided it into weeks, and set apart every seventh day for a Sabbath. . . . [B]ut as for an exact reckoning of days, after I had once lost it, I could never recover it again.
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> —Daniel Defoe, *Robinson Crusoe*, 1719

The integrative theme in this work is the drive for uniformity as it affects the public. Without stable systems of consistent measurement of all kinds, the vast majority of our daily transactions would be problematic at best. For example, absent carefully crafted agreements regarding public time among regions and countries, a passing stranger's query "What time do you have?" would require a ponderous response. And without a common way to locate places on maps and charts, we would always be making back-and-forth conversions while estimating distances—producing errors during the process.

Time—mean solar time as displayed on a clock—and longitude are linked. On average, one complete rotation of the Earth about its axis takes twenty-four hours, and the globe's circumference is divided uniformly into 360 degrees. Thus one hour of mean time corresponds to 15 degrees of longitude, and in the same way 1 degree of longitude corresponds to four minutes in time.[1] In addition, placing a network (graticule) of parallels and meridians encompassing the surface of the earth in order to designate locations has been employed for centuries, with parallels of latitude enumerated as (0–90) degrees north or south of the equator. Unlike latitude, however, there is no obvious start point for the meridian lines that specify east–west positions. Throughout most of history, map and chart makers chose arbitrary beginning points (often a landmark in their own locality) for the initial meridian of longitude. A few hundred years ago it became apparent that adopting a common

initial longitude offered advantages to ocean navigators and geographers, but not until a century and a half ago was this feasible.

Like the suggestions for unifying longitudes, proposals for unifying and simplifying the public's reckoning of time came from experts anxious to resolve some particular discrepancy or ambiguity. Efforts to change people's habits, however, generally meet stiff resistance, for most individuals are quite comfortable with their accustomed ways and see no reason to change. Consequently, most reforms in time reckoning have come only after decades, sometimes centuries, of intense discussions and negotiations.

Perhaps the most famous alteration in time reckoning was the replacement of the Julian calendar by the Gregorian one. In 46 BC, Julius Caesar reformed the Roman calendar, then badly out of synchrony with the seasons. His calendar was a solar one having 365 days in a year with an additional day inserted once every four years, giving an average calendar year of 365¼ days. Since this period was slightly longer than the length of an astronomical year—the required interval for the earth to circle the sun and return to the same place in its orbit—astronomically based events began occurring earlier and earlier according to the Julian calendar. The discrepancy between the two was small, a shift of one day in 128 years, but it grew as the centuries accumulated. By 1300 the vernal (spring) equinox, a defining point in the earth's orbit, fell on 11 March, ten days early. Moreover, full moons now came three days earlier by the Julian calendar. As a result, calculations for Easter Day, which use both calendar values, were wrong.

In 1582, after centuries of suggestions for reforming the calendar, several failed attempts to do so, and a difference now amounting to ten days, Pope Gregory XIII accepted the report of a commission he had established to consider the various proposals. On 25 February he signed a papal bull to put the changes into effect. Ten days were dropped, so that 15 October came just after 4 October, and the vernal equinox was returned to 21 March. In addition, to ensure that the calendar year and the astronomical one now coincided, the Julian calendar's leap-year rule was altered: Every four years a day would continue to be inserted, but with the exception that only those century years divisible by four hundred (i.e., 1600, 2000, etc.) would contain the extra day—that is, 1700, 1800, 1900, 2100, and so on are not leap years.[2]

The switch in calendars took place in Catholic Europe starting in October 1582 but as late as 1585 in Spain's overseas possessions.[3] England and her colonies did not adopt the Gregorian calendar until September 1752, nearly two hundred years after it was first instituted, and its adoption by countries such as China, Soviet Union, Greece, and Turkey did

not occur until the twentieth century. Even today, the Gregorian reckoning is still not used by all practicing Christians, nor by Muslims and Jews, who are guided by their own religious calendars. Despite these exceptions as well as a host of proposals from reformers anxious to improve the "regularity" of calendar months, the Gregorian calendar is the calendar for commerce everywhere and for nonreligious time reckoning. It is likely to remain so.[4]

The day itself was also partitioned early on, with the Egyptians dividing it into twenty-four parts, twelve for the nights and twelve for the daylight periods. Slowly, and then more rapidly with the fourteenth-century invention of the clock and subsequent improvements in accuracy, these twenty-four parts, long of unequal duration according to the seasons, became equal. Time by the clock, with hours of equal duration, became the norm, and the average of the length of a year of solar days—the mean solar day—became the standard.

Much of our story takes place during the era when, for public activities, time by the clock was customary, with its divisions of the hour into minutes and seconds and even small fractions of a second. Every place was keeping its own civil time: mean solar time, with noon when the (mean) sun crossed the locale's meridian. These differences in local time varied systematically and in a simple-to-calculate way: the civil time of any place to the east of one's locale was later, the civil time of any place to the west was earlier.

Our story begins in the sixteenth century, after Ferdinand Magellan's surviving crew had circumnavigated the globe. Nearing home, they were shocked to find that the day of the week they had entered in their log differed, by one day, from the day of the week on land. Like the quote from Defoe's *Robinson Crusoe* that opens this introduction and the illustration that provides the frontispiece for this book, these chroniclers began to worry that they had not kept an accurate record of the days, events, and especially the Sabbaths during their years away from "civilization."[5]

Both the explanation for the cause of the disparity in days and the need to adjust a ship's reckoning to compensate for it soon became common knowledge. Nevertheless, circumnavigations over the following two and a half centuries gave evidence that an agreed-upon place to make a change in date would reduce ambiguity in describing events and other happenings. The challenge of locating the International Date Line—an imaginary demarcation that twists and turns as it sweeps across the Pacific Ocean—came to the fore in the nineteenth century, the same era in which other aspects of time uniformity became subjects of interest.

The second part of our story, the drive to increase uniformity in timekeeping, starts in 1870, when scientists and professional societies began

in earnest to address the problems created by the multiplicity of initial meridians used on cartographic products: maps and charts at all scales, sailing directions, and the predictive tables of celestial events issued annually for ocean navigators and astronomers. As we shall see, numerous proposals for a common initial meridian were advanced. Around 1879 longitude and time came together with the first systematic advocacy for a single time to be used everywhere. That common time was to be tied to the selection of one globally recognized initial meridian. A torrent of studies from different professional societies followed, offering proposals for various ways to achieve a more uniform time.

I shall also examine how the linked topics of uniform time and the selection of a prime meridian for specifying longitude were gradually taken up by central governments, and I will trace the paths by which legislation was introduced and finally passed in country after country that established a system of national times. Similarly, I will consider in detail the lengthy process by which a common meridian was adopted and comment on why the processes leading to it and to uniform time took so long and which individuals and countries caused delays.

The last part of the history of the campaigns for time uniformity introduces an entirely new concept: clock time as a social instrument. In 1907 one private individual, a London builder of fine houses, brought this idea to public attention when he proposed that clocks in England be advanced during the summer months, allowing society thereby to gain the benefits associated with having more daylight in the evenings. His proposal, which required altering public clocks twice or more each year, was opposed by many astronomers and other scientists. Yet within less than a decade, the seasonal time shifting of clocks had taken hold throughout most of Europe, in North American countries, and in the more temperate regions of the Southern Hemisphere. The process by which Summer Time became the norm for the United Kingdom and most of Europe is of particular interest today in view of the current debate in the United States and elsewhere over proposals to extend "daylight saving" time or even make it permanent.

In the United States altering public time via shifting public-clock displays has antecedents different from those articulated in Europe. The piecemeal approach to periodically advancing public clocks burdened the country with four decades of timekeeping troubles, which were not resolved until passage of the Uniform Time Act of 1966. Some of the issues encountered during those forty years of nonuniformity are addressed in the epilogue. There you will also find a brief discussion of the trade-offs, involving benefits for some and problems for others, that

inevitably result when time shifts are extended for periods longer than the five summer months.

Even today complete acceptance of several uniform-time conventions has not occurred. For example, Newfoundland, India, and Afghanistan have not adopted the worldwide system of hour zones in toto, preferring instead to link their civil times more closely to the country's local time. China ignores the concept of hour zones linked to geography and maintains one single time throughout the country. And some regions in the United States and Canada do not observe annual shifts in civil time, preferring the simplicity of clocks that are not altered twice a year.

The lack of uniformity in civil timekeeping still troubles some. Inevitably, proposals to remedy this lack will be advanced. This book looks at past problems and their resolution as guideposts and warnings for future generations, who will undoubtedly struggle not only to regulate the public's time, but also to maintain cooperation when setting consistent, stable, and acceptable standards in multinational public activities.