of course, this very capacity to speak for himself is one more thing that put Groucho so far ahead of Harpo and Chico, and left him so much more vulnerable.

There is a built-in scenario in the TV Groucho who could talk anyone down, and be loved for it, and the scourge of wives sent out of the room in tears by his barbs. Is cruelty the word? Does the answer depend on whether you are Groucho or the wives? Is it just that comedy gives an uneasy extra liberty to unkindness? Erin Fleming was less another Margaret Dumont (who elects to ignore Groucho's worst insults—a further castration) than the hand that rocked the cradle of an old guy who was cracking up. It is a wonder in these ghoulish and professionally cruel times that we have not had a movie of the last years of Groucho. What a farewell it could be for Billy Wilder, with Jack Lemmon as the fragile Groucho, and Julia Roberts as this other Erin....

Sooner or later, clowns are remembered for such disasters, and Groucho may yet resemble Charles Foster Kane in his last years. But this celebration of the Marx boys is a fair moment to wonder what is happening to this country's great tradition of screen comedy, especially the form called physical comedy. Again, I don't think that we are going to get the kids any longer to sit down with the treasury of the Marx Brothers, Fields, Keaton, Chaplin, or Harry Langdon. Even children today sense that there is a gross-out factor in comedy that gets steadily nastier every few years. So for now the question is just how far Jim Carrey or Eddie Murphy can go. I mean, will go. And Carrey, I suspect, is every bit as deserving of our attention as Groucho was, and every bit as tortured by wondering whether it is his melancholy or his rare good humor that serves him best as a clown.

Maybe, when all is said and done, film is an unlikely medium for the "anarchic" comedy that we admire in these guys. When so much is canned, premeditated, labored over, and set down in stranglehold permanence, it is remarkable that spontaneity ever survives. From Keaton to Carrey, from Lenny Bruce to Sandra Bernhard, there have been performers who have to feel the moment and the pulse of a live audience—and then they have been asked to recreate liveness on a film set.

Louvish and Kanfer make it clear beyond dispute that the Marx Bothers were most themselves—most dangerous, most lyrical, most at play—when they were on stage, and when the collective notion took them. They were also most fraternal in those circumstances, the one picking up the other's timing, without envy or rancor. For once, at least, the shared upbringing of family life paid off. Who's to say they were not at their best in Spokane in 1923? Similarly, would you prefer the Jerry Lewis out-takes from one of his Paramount pictures, or a rough record of him and Dino doing three hours at some club before anybody raised the possibility of movies?

John Grierson, the Scots critic and documentary filmmaker, was one of the first of the Marx Brothers' fans to see the straitjacket in film. He saw great clowns—timeless figures, especially in unison. And he saw that they might go further still, "if, that is to say, the commercial cinema permits them to polish their roles, and refine the Idea that is in them," he wrote in 1930. "It is, I admit, a good deal to ask of an institution which has destroyed Langdon and cast away Raymond Griffith. What rare and noble clowns those two might have been."

When Grierson wrote those words, the Marx Brothers were still at Paramount, doing their thing with inconsequential Magritte titles: *Cocoanuts*, *Animal Crackers*, *Monkey Business*, *Horse Feathers*, *Duck Soup*. The purists say that those are the best films, the ones closest to the stage act. Yet hardly anyone alive remembers that show now. They moved on to MGM and the polite, sensible control of Irving Thalberg, who sent them out under such useful titles as *A Night at the Opera* and *A Day at the Races*. It was part of Thalberg's genius that he was wary of the wildness in the boys, and so he pushed songs and romantic sub-plots into their pictures. The results are less pure, but the boys doted on Irving. The anarchists wanted a kind boss.

Jim Carrey, I daresay, ponders that every day, and when he stops laughing at possible new jokes and routines, there is still time for the rictus grin of horror to settle in if someone says "Raymond Griffith" in tones that plainly demand respect and reverence. And remembrance. Comedy comes quickly, and goes faster. ■

Writing the history of time.

Greenwich Village

By D. Graham Burnett

I.

At 4:45 PM, on the afternoon of February 15, 1894, a Thursday, a sharp pop sounded unexpectedly below the north wall of the Greenwich Observatory. Setting aside a series of astronomical calculations, two curious observatory staffers trotted to the gate and peered down the path that led from the distant Thames, crossed the broad green turf, and mounted the steep hill to their chronometric fastness. What they found was not pretty. The majority of Martial Bourdin, a 26-year-old Frenchman, lay on that path, but a not insignificant amount of him had been spread unevenly across the sixty yards separating his body from the wall of the observatory compound. What was clear was that Bourdin had been carrying a highly explosive device up to Christopher Wren's red-brick baroque manor-house *cum* celestial citadel, to the buildings that housed the instruments that defined the prime meridian of the world. What was not clear, and has remained a mystery ever since, was why.

In the weeks that followed, foreign anarchists took the rap—round-ups and deportations cut into loose London networks of heavily accented *Autonomistes*, free-form dissenters, and sundry visionary agitators from the lower classes. But the meaning of Bourdin's failed gesture of chrono-terrorism remained elusive. Joseph Conrad called it "a blood-stained

The Story of Time
by Kristen Lippincott et al.
(Merrell Holberton, 304 pp., $45)

inanity of so fatuous a kind that it was impossible to fathom its origin by any reasonable or even unreasonable process of thought." Between the puff of pink mist in the park and the unscratched walls of the observatory, he asserted, there was "nothing resembling an idea, anarchistic or other." Here lay a formidable challenge to his narrative imagination: an act apparently beyond the explanatory power of sanity and craziness alike; an eruption of ideological violence unencumbered by any actual idea.

Piqued, Conrad set to work on what

D. Graham Burnett's book, *Masters of All They Surveyed: Exploration, Geography, and a British El Dorado*, has just been published by the University of Chicago Press.

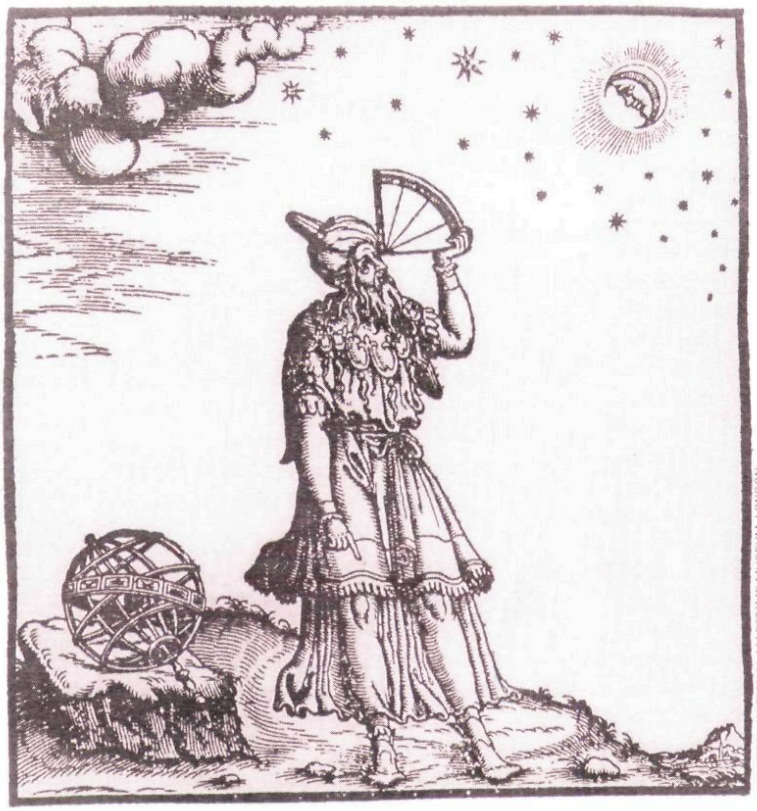
would become one of his very greatest novels, *The Secret Agent*. There he accounted for the unaccountable, weaving an explanation of the Greenwich plot as deliciously perverse and maddeningly irrational as the geopolitics of modernity: in his fiction the botched job was the brainchild of reactionary, repressive forces, anxious to shake the British from their romantic commitment to personal liberty. From the perspective of these pluto-aristocratic internationalists, the English public seemed distressingly attached to protecting the rights of every impecunious nonconformist and radical. Only an act of gratuitous and destructive blasphemy (attributed to those uppity proletarian factions), it was reasoned, can prompt John Bull to support a properly authoritarian pan-European backlash. Bombs in shops, assassinated worthies, even smoking churches—these petty acts can always be explained away as responses to understandable grievances: hunger, poverty, enthusiastic religious antipathies. But an entirely incomprehensible blow against something wholly beyond reproach—this has the power to produce mass terror.

As the shady "Mr. Vladimir" explains, "it would be really telling if one could throw a bomb into pure mathematics." And failing that, the best option is Greenwich: the international symbol of precise astronomy, the temple of pure learning, and, since the International Meridian Conference of 1884, the global *punto fijo*, the anchor of the world's spatio-temporal framework. The bomb in Greenwich promised to be the apocalypse of progressive, liberal, Victorian Britain. It would be, in more ways than one, the end of time.

Rumor has it that the most recent James Bond film, *The World Is Not Enough*, was to have reprised this chiliastic plot by having the baddies try to blow up some portion of the world from Blair's Millennium Dome (in Greenwich, of course, on the prime meridian, under the very shadow of the old observatory) just as the calendrical odometer rolled over into the year 2000. This got vetoed, in the end. Presumably the Dome had received enough bad press, and no one wanted to give unimaginative terrorists a good idea. When December 31, 1999 actually arrived, and 39 tons of (licit) explosives set the river ablaze, Greenwich—site of a $10 million police mobilization to guard against Bourdin's durable fantasy—looked suspiciously like the police state that Conrad's conspirators hoped to bring about.

That the "home of time" should keep ticking like a mine in our collective imagination points past 1894 and the misfortunes of one disgruntled French pseudo-anarchist to something deeper. That ticking, one is tempted to suggest, is nothing less than the sound of the heart shared by the mechanical clock and the bomb. Time and death tap in step.

This is an old truth. Ancient, even. The Orphic cults of the primordial Eastern Mediterranean made the relationship genealogical: *Chronos*, the ur-father, begat *Chaos*. The global catalogue of similar myths would be long indeed; but there is no need to go trolling through the nebulous fascinations of Zurvanite heresies, Xipe flayings, or the worship of Kali, the blood-soaked aspect of Shiva, in order to demonstrate the extensive entanglements of time and destruction. Take something immensely concrete—say, a time-bomb. For all the fuss the French made on discovering, at the height of the Napoleonic Wars, what they called "*les machines infernales des Anglais*" (clockwork charges used to scuttle ships at anchor), the time-bomb's lineage stretches back practically to the origins of the clock itself.



COURTESY NATIONAL MARITIME MUSEUM, LONDON

Silvio Belli, "Libro del Misurar con la vista," 1569

That wondrous innovation of the early fourteenth century, the weight-driven, escapement-regulated clockwork, found its way briskly into the service of that perennial human project: destroying cities. In a delicately illustrated pyrotechnical handbook from 1568, preserved (ironically enough) in Dresden, an early modern blaster and bomb-smith detailed the booby-trapping of a city to be abandoned to its besiegers:

> One can, with hidden buried explosives, throw such an obstacle in the face of the enemy that within two or three days he will come to regret his conquest: namely by placing, buried into the earth, one great fireball, or several in various places in the chambers and rooms and also in the stables, with a running clock attached with a fire lock ... A number of such hidden explosives can be delayed as long as one wishes, and set at such hour as one desires.

The same device that could, on cue, swing the bell-hammer of an automated *jacquemart* to announce the hour required little modification to trip the striking arm of the newest thing in firearm mechanisms, the *snaphaunce*, a forerunner of the flintlock. From tick, tock, *ding!* to tick, tock, *BOOM!* required just a bit of fiddling, and less than a century.

Not that the latter hadn't been on people's minds even earlier. When the Renaissance Spanish cleric Cristóbal Gonçalez recorded his *Consideraciones sobre el Psalmo 133* ("Behold, how good and how pleasant it is for brethren to dwell together in unity!"), he interpreted universal harmony in terms of an extended metaphor that drew on the new clockwork technologies:

> If we look at a clock we shall find therein a whole host of springs, wheels, chains, pins, cogs, and weights, all of which move and function so that a bell, placed in the topmost part of the mechanism rings and strikes the hour ... After this fashion we may philosophize about the whole fabric of the world, which is like a clock, set by God on those mighty wheels of the heavens.

Gonçalez recognized an unexpected

aspect of this analogy: the whole of the clock worked to ring the big bell at the appointed time—and in the same way, the whole of the heavens were arranged for what? To sound the final trump when the hour came! The "clockwork universe," so fascinating to both theologians and natural philosophers well into the seventeenth century, was actually an alarm-clockwork universe, in which the big bell would ring the apocalypse itself. We live, as Gonçalez pointed out, in the ultimate time-bomb. Newton himself, equally involved in the mechanics of the celestial mechanism and the precise exegesis of the Revelation of Saint John the Divine, would have agreed.

Conrad grasped the predicament so thoroughly that he made the ultimate time-bomb a central figure in *The Secret Agent*. The pale presence of death who haunts the book, "the Professor," has only one aim in life: "a perfect detonator." As he puts it, "I am trying to invent a detonator that would adjust itself to all conditions of action, and even to unexpected changes of conditions. A variable and yet perfectly precise mechanism. A really intelligent detonator." The device that he designed to blow up Greenwich combined a clockwork countdown with an inertial override: it would go off in twenty minutes unless it was bumped first. It thus had both an inner temporal order and an acute sensitivity to local conditions.

Too acute, in fact. It went off prematurely when it was accidentally dropped. Undaunted, however, the Professor presses on, always carrying on his person a guarantee of personal inviolability in the form of a suicide engine: an explosive he can trigger by squeezing a bulb in his pocket. We are to understand, of course, that *he* is the intelligent detonator, and as such the very angel of the apocalypse. And yet he has been unable to make even that device truly perfect: try as he might, he cannot make it instantaneous—a delay of twenty seconds must be endured between his hitting the switch and the fiery end. One senses Conrad playing on the image of real Apocalypse: "When the Lamb opened the seventh seal, there was silence in heaven for about half an hour."

II.

RECENTLY THE Queen's House of the National Maritime Museum (a square-ish sugar-candy by Inigo Jones that sits at the base of Greenwich Hill) hosted an exhibition called "The Story of Time," more than 500 objects arranged to offer an "all-encompassing history of time across the earth from the earliest civilization." Until very recently, it was possible to leave this stimulating show, and cross town, and terminate all reflection on time by going upstairs in the British Museum for a look at "The Apocalypse and the Shape of Things to Come," where three large rooms documented the pervasive and plastic legacy of the Book of Revelation's imagery. Both shows have been rendered more permanent by large and glossy books, heavily illustrated and larded with uneven essays.

The British Museum's volume, edited by Frances Carey, shares in that show's scholarly, not to say dutiful, feel: many a Renaissance German woodcutter, from Augsburg to Worms, tried his hand at the suite of Revelation images that Dürer made immortal at the end of the fifteenth century. Their many Whores of Babylon share a wanton plumpness, their seven-headed beasts snarl nastily, one after the other. To be sure, there is much more to the legacy of the apocalypse than this: David Bindman's essay casts light on a collection of garish English popular prints from the eighteenth and nineteenth centuries, many of which deploy apocalyptic imagery to slander the French Revolution and its spawn; and sections on the World Wars and the "celluloid apocalypse" demonstrate the durability of Saint John's terrible visions. Still, it is the ranks of studious, pug-nosed, Teutonic images of destruction—the early, intaglio versions of what comes down to us as the Iron Maiden album cover—that predominate. The apocalypse is a rather long-faced business in most of the Western traditions, and the Germans do deserve a special place in the story, again and again.

"The Story of Time" exhibition is rangier, baggier, more wackily encyclopedic. How else to characterize the juxtaposition of three stuffed stoats, Jasper Johns's *Four Seasons* prints, and several rooms packed with astrolabes and sundials? But the show is also, for all its curiosity-cabinet sensibilities (or perhaps because of them), a good deal more fun. If the text of the catalogue induces a number of groans ("Cultures that have grown within an unpredictable or hostile environment often see the universe as being similarly fraught with dangers"), only a dull soul could read it without any stimulation. Kirsten Lippincott, the director of the Royal Observatory Greenwich and the show's curator, has tried to bring order to the profusion of things temporal under five headings: the creation, the measurement, the depiction, the experience, and (inevitably) the end of time. And as keeper of the Greenwich flame, and steward of its large collection of antique navigational and chronometric instruments, Lippincott's interests clearly lean toward mensuration; and about half of *The Story of Time* deals with time's

measurement at both the calendrical and the horary scales—from Egyptian gnomons and Babylonian planispheres to the BBC's "six pips" time signal.

HISTORIANS HAVE TAKEN the history of timekeeping seriously for quite a while. Pliny, in fact, summed up his history of technology chapter in the *Historia Naturalis* by asserting that the measurement of the hours was one of the first three things to be agreed upon by all civilized nations. (It immediately followed consensus on the shaving of male facial hair.) But while the history of timekeeping has never really been overlooked, until quite recently it has been treated in two very different ways.

The inner workings of clocks and watches—the detailed history of these complex pieces of technology—have been the provenance of highly specialized horologists, often collectors and connoisseurs, antiquarian in spirit and interested in timekeeping mostly as a sequence of mechanical challenges progressively surmounted by the inspired craftsman. But while these types gathered around the back of the clock to get a look at the moving parts, another group of historians kept their distance, gesturing at clocks as either symbols of, or the impetus to, vast sociological transformations in European history. For Engels, for instance, as for Marx, the factory clock represented the transformation of agrarian work rhythms into the monetized time regimens of capitalist exploitation. Weber saw in the same device further evidence of the spiritual order that made capitalism possible: the clock had been a central feature of monastic life. (Indeed, the mechanical clock may have been invented by a Benedictine monk trying to figure out how to ensure that he and his brethren did not sleep past the "eighth hour" winter reveille stipulated in the order's rules.)

For Weber, the temporal order of the factory mirrored that of the monastery. A series of twentieth-century French historians (Marc Bloch, Jacques LeGoff) built on these ideas, and those of Weber's rough contemporary Gustav Bilfinger, to argue that the rise of mechanical time-measurement in Europe, and the spread of public striking clocks from the fourteenth to the sixteenth centuries, amounted to nothing less than the rise of modern, urban, bourgeois life. Down went the cycles of "church time" and pastoral seasons; and in came the linear time of merchants and modernity, the hustle of time-as-money, the ringing sound of a secular civil regime.

Between the grand theorists who wove these arguments and the open-case horological historians, few words passed. The astronomical tower clock of Su Sung helped to change this. In the late 1950s, Joseph Needham, the great authority on Chinese science, and Derek de Solla Price, a leading historian of technology, began to collaborate on a history of this stupefying device, essentially unknown in the Western historical tradition, which has long been content to dismiss the mechanical skills of the East. It turned out that in the eleventh century, a Chinese engineer named Han Kung-lien designed and built an enormous clock, more than forty feet in height, which used an elegant escapement-regulated water-wheel to turn the elements of a complex model of the heavens—the paths of the planets, the sun, and the fixed stars, all as seen from earth. Nothing of comparable sophistication existed anywhere in Europe for several hundred years, and it seems possible that the Su Sung *astrarium* kept better time than any device on earth until the invention of the pendulum clock by Christiaan Huygens in the late 1650s.

WHY DIDN'T chronometrics thrive in China in the years after the Su Sung clock's destruction? Could such a wonder have been simply a technological dead end? These questions fit nicely into what came to be known as the "Needham Problem," namely, why did the "scientific revolution" happen in Europe, when, on so many fronts, the Chinese seemed much farther "ahead" much earlier? Needham believed that China's contributions to the history of science and technology had been forgotten and obscured, and he argued, with Price, that rumors of the Su Sung clock must have made their way during the medieval period across Asia, into Islamic countries, and from there to Europe, where they provided the inspiration for the development of the escapement—that essential inner bit of the mechanical clock, the part that, by tipping back and forth, stops a weight-driven wheel from just accelerating (as the weight falls), and instead turns its motion into a series of little, equal ticks.

What Price and Needham were proposing was a new origin for the mechanical clock: it came (however indirectly) from China, and it began in an effort not to keep the hours of the day, but to model the universe. Forget the monks trying to figure out what time to wake up. The origins of the clock lay in loftier things. With all the exuberance of discovery, Price gave this new account a stirring turn of phrase: "The mechanical clock is nought but a fallen angel from the world of astronomy!"

Here were big claims. They might be right, and they might be wrong; but deciding them would demand attention to the history of precision instrumentation—Greek gearing, mechanical astrolabes, the earliest escapements—and of the communities tinkering with the devices. Were they interested in the workings of the cosmos? Or in the correct schedule for vespers? Were they interested in astronomy? Or mere "time measurement" for quotidian affairs?

The bad news is that there is currently no strong consensus on answers to these questions, though not for lack of effort. The archives of Europe have been ransacked, but there seems to be no "smoking gun" on the inventor of the escapement clockwork in the West, so his links to Eastern learning (assuming a "he" here) cannot be known. Moreover, the Needham Problem has fallen from grace a bit, as historians of European science have spent much more time in the last twenty years calling into question just what the scientific revolution actually was (if anything). This has left little time to think about why other folk were not having one.

Still, Price and Needham inspired a new kind of time history, work that combined big-theory hypotheses with inside-the-case attention to detail. One might point, for instance, to David Landes's wonderful book *Revolution in Time* (1983), which combined a meticulous history of the precision watch with a sweeping argument for the rise of "private time": the internalization of time discipline that those instruments made possible. The integration of scholarly perspectives has greatly raised the bar for what the history of time can be. It has made these studies harder to do (and perhaps to read), but much, much richer.

III.

WE HAVE, IN our individual consciousnesses, an "experience" of time. Presumably human beings have always had such an experience. At the same time, societies must share temporal orders—units of duration, sequences of these units—if people are to cohere in the most rudimentary ways. It seems impossible to imagine that the systems used for measuring time—sundials, clocks, the migrations of birds—have not played central roles in both of these encounters with time, the existential and the social.

It is one thing to say this in a general way, another to try to triangulate personal, cultural, and "technical" time in a particular instance. Yet this is what the new historiography of time demands. When someone pulls it off, the results sparkle. In a recent essay on Einstein, for example, Peter Galison has shown that one of the most remarkable and abstract innovations in twentieth-century physics, rela-

tivity theory, cannot properly be understood without considering the contemporary efforts to standardize railroad clocks across extensive networks in Europe, systems that were part of a broader transformation in the experience of time at the turn of the century (a story told by Stephen Kern in his book *The Cultures of Time and Space, 1880-1918*). The patents for such electronic distributed time devices, interestingly, were the young Einstein's responsibility in his day-job at the Bern patent office.

The Story of Time is essentially a gallery of images, and its short interpretive essays must survey large areas—"Time and Space in Islam," "Cyclical and Linear Concepts of Time in China," "Time and Art in the Twentieth Century"—and therefore cannot do the subtle work that I have been describing. Yet *The Story of Time* has been informed by these trends in the historical literature, as well as by the insights of archaeo-astronomers (who have contributed much to current understanding of the temporal regimes of ancient civilizations, particularly those of the Americas) and anthropologists (whose discipline can be said to have been in part founded, via Durkheim, on the investigation of time as a social reality). Moreover, there are compensatory advantages to the breadth and the diversity found here. What *The Story of Time* does best is cast up tantalizing suggestions of how different one's sense of time might be.

The most interesting objects presented possess in their very form the power to pose this challenge. Take, for instance, the Japanese *Jikōban*, or "time incense tray," a box that enabled the hours of the day to be maintained by the sequential burning of carefully arranged scented blocks. Some versions apparently used different smells to mark the passing of time, and a particularly refined Chinese version passed the smoke of the hour through a grille in the form of the "double-happiness" character, while the ash fell through another template, leaving dust in the pattern of the character for "longevity." Here is a richly evocative clock, a moralized timekeeper that suggests a very different culture of time: slow smoldering, encompassing the senses, requiring exacting custodial attentions.

Who knows exactly how time was experienced in a seventeenth-century Buddhist monastery? Reading the description of the *Jikōban* in this book will not answer that question, nor can Joy Harvey really do justice to it in her perfectly helpful essay on "Time in a Japanese Context." Looking at the device, however, certainly makes one wonder. Particularly when one can flip forward and consider the ticking iron chamber clocks of early modern Europe. One cannot help sensing that a contemporary abbey in the Alps would have offered a very different temporal regime. Such charged, if elusive, juxtapositions abound.

My example runs the risk of catching me in the same awkward posture that *The Story of Time* sometimes adopts when facing East. It isn't precisely that one can accuse the text of a pernicious Orientalism, but rather that when the time comes to confront the mysterious qualities of time, an Asian icon is likely to follow. This was quite strongly marked in the exhibition itself, where the first room of "The Creation of Time" was dominated by a large bronze of the "Dancing Shiva," and the very last exhibit, at "The End of Time," was a large gilt "Seated Shaka" accompanied by a bit of verse on the silence of the Buddha in the face of our questions. (The book ends the same way.) A long and enlightening story could be told about the European tradition of pushing the hard questions Eastward. Over there, we have often dreamed, they have the mysteries worked out.

Anyway, to compare a ritualized and polite device such as an incense clock to a verge-and-foliot clunker is really to compare apples and oranges. After all, it is not as if Europeans did not have their own moralized and ephemeral techniques for time-telling: sacral candles and spirit lamps were marked for this purpose; and the hourglass, with its suggestive form and its quiet flow of dust, was both an extremely important tool for keeping track of time well into the modern period, and just about the most overused didactic icon of the emblematic tradition. An early fifteenth-century moralist went so far as to argue that sandglasses ought to be installed throughout public places such as schools and libraries, "so that we can see time itself flowing and fading away"—an inducement to focus on higher things.

IV.

While it cannot be denied that Europeans have infused timekeeping systems with a host of meanings, there remains a strong lingering sense that this history of moral and artistic representation is not the real story of time in the West. The real story has to lie in how it happened that Western Europeans got so obsessed by precision timekeeping that they ended up making devices more regular than the rotation of the Earth itself, devices so insanely reliable that they will not vary by more than a second in ten million years. The history of these increasingly precise timekeepers is a central part of the history of science itself: such instruments made pos-

sible the astronomical observations that have grounded theories of the physical world; and Newton's universal mechanics postulated a notion of "absolute time" that one assumes was influenced by clock-time.

The master narrative of this story is one of abstraction. What this means is that the history of timekeeping in the European scientific tradition is most easily presented as a history of separating "time" from the vagaries of the physical world, a history of purifying some sort of essential, disembodied, precisely monitored flowing, purifying it both from the contamination of symbolic hoo-ha (the Book of Genesis, the Apocalypse), and from the various things that were once taken to embody that flowing—the seasons, the movement of the sun and its shadows, even the spinning stars. The result (measured by a pendulum in a vacuum, or, now, by the oscillation of quartz crystals, or, better yet, by monitoring of the radioactivity of cesium-133) is supposed to be *just time*.

IT IS A good story, and a powerful master narrative, one that recapitulates the basic form of positivist history of science, in which conceptual advances result from a sequence of iconoclastic blows that split away the accretions of myth and spurious "meaning-making" from the resilient core of the really-real, which is made suddenly present, revealed. Sociologists of science such as Bruno Latour have gone to considerable lengths to show just how profoundly odd this theory of knowledge works out to be, what a mythopoeic drama it, in fact, embodies. Yet these criticisms demand a gymnastic intellect: one must be prepared to try to imagine a world in which our hallowed distinction between made-things and found-things dissolves, where one can look at what seems to be an autonomous "fact" of nature (say, time) and hear in that word the strange contradictions of its etymology—"fact," perhaps tellingly, traces its roots to verbs like *facere*, "to do, to make." Does this give a clue? For Latour and others it suggests that the distinction between what is real and what is made is a false one; what is real *is* what we have made.

Even if one is not persuaded by such arguments, they serve as a warning about certain master narratives of scientific progress, particularly those that depict the veritable thing under investigation being, over time, freed from encumbering layers of superfluous symbolic baggage. Where the history of time is concerned, however, the old-fashioned sort of narrative retains a great deal of appeal. There is something pleasing about the powerful scenes on which such an account trades. The German sociologist Norbert Elias believed that he had located the actual birth-moment of the Western concept of non-social, non-human time: call it 1604. It was around then that Galileo, at work on the dynamics of falling bodies, switched from using his own pulse to using a pendulum as a tool for measuring physical phenomena; and in that moment time was torn forever from flesh and blood.

It is not clear that this really happened, but it makes a great set-piece. And the accounts that treat European timekeeping as a progressive, secularizing abstraction can offer plenty of other classic moments. Take the wonderful Reformation-era statute promulgated in Wolfenbüttel, which advised the citizenry that the ringing of the hours from the church clock was no longer to be confused (as in "popedom") with a call to pray to Mary (who "does not wish to have such an honor"), but would henceforth indicate merely the hour. Here, surely, is the birth of "meaningless" time.

Or take an instance dear to historians of science: it turns out that if you think of a "day" as the period of time that intervenes between twice having the sun directly overhead, then a "day" varies in length as the seasons change (if you are measuring it with a clock). What this means is that if you are keeping clock-time, and your neighbor is keeping time with a sundial, then your neighbor will show up sixteen minutes early for supper in late October, and, worse, fourteen minutes late in February. Astronomers had understood something of this from the medieval period on, but it took the rise of precise pendulum clocks in the seventeenth century before the detailed relationship between "solar time" and "mean time" (that of the clock) could be worked out, and represented mathematically in something called "the equation of time." The tectonic significance of this discovery deserves emphasis: the sun no longer kept time, but people "corrected" it with clocks. Time, one might want to argue, was leaving the world behind, and the clock was the cause of it all.

A fair bit of the stuffing in these kinds of stories has been inserted by those interested in setting up a straw man to beat the stuffing back out of. A somewhat nostalgic critique of abstract time—of that disembodied "clock" time—has been around for quite a while, long before the critical machinations of post-modern science studies. Henri Bergson, at the turn of the twentieth century, began a blistering assault on the temporal conceptions of modernity, arguing that, in effect, the only *real* time was the "duration" of the present—the experienced time of being itself. Neither philosophers nor scientists, he asserted, had ever taken the present seriously. To the contrary, modernity had

Señor Quevedo pictures the brevity of his own life, and how nothing seems to have lived

"So! Life . . . ?"
Nobody there?
Fortune's chewed
my years off
Madness
hides the hours
now

Who's strong enough
to know
where
youth, health
fled?

Life's gone away
Memories crowd up
Evils
walk about me

Yesterdays: done
tomorrows not yet here
today
hurls itself
on a point

I am I've been
Ile be
a tired
Is

Today, tomorrow, yesterday
I knot diapers
to shrouds

and endure:
a cavalcade
of deaths.

Allen Tice

turned this portion of time—the time in which we all lived—into nothing more than the razor's edge between the past and the future. (Arriving an hour late for a North American interview, Jorge Luis Borges is said to have pointed to the clock on the wall and announced: "Man made the clock as an extension of his sense of time, now he confuses the clock with time itself. We of the South reject this: the time that things occur is real and reliable; clock-time is a fantasy, highly variable, not to be trusted.")

The Story of Time, omnivorous, tries to engage with this sort of time-thinking in its section on time as "experience." Here one finds the most haunting exhibit of all: a set of Christmas self-portrait stereo-postcards taken by a German couple in their modest *Kleinburgher* parlor every year between 1900 and 1945. To be able to survey the passage of a life in this way is a moving experience, even setting aside the sociological interest afforded by the couple's efforts to represent the historical events of each year: a proud map adorned with flags in front of the Yule-tree in 1915; heavy coats to show the shortage of fuel two years later. It is a pity that the book has reduced the full suite to a mere eight (non-stereo) images. One loses the sense of flow.

And the flow is relentless. It is the governing irony of this tale that the very profusion of time imagery, time devices, and time stories seems to work, perversely, to reinforce the relentless passage of plain old time itself. Both the book and the exhibit go to great lengths to present a fabulous and exotic colonial garden of time, culled from a pan-human expedition and all transported to Greenwich for delight and instruction. Yet the subtle, powerful, and submerged narrative of scientific time—that inhuman passing, indifferent to our efforts to scent it, color it, and render it in music—*that* kind of time whispers through Greenwich, the ancient home of the time's science: *Et in arcadia ego*. Hustled out of the closing exhibition by shade-like guards, I found myself on Bourdin's fateful path, in the sun, under the observatory, feeling mightily depressed.

V.

WALKING UP THE hill for a peek at the observatory itself left time for reflection on yet another irony of the history of time. For in these precincts, where one can see the original "time ball" atop the observatory towers (the forerunner of our New Year's ritual at Times Square, the Greenwich time ball has dropped at 1 PM daily, since 1833, as a signal to ships in the Thames needing to set their chronometers), it is difficult to forget that most of the technical innovations that led to the increasing precision of mechanical timekeepers—and hence, it would seem, to an increasingly abstract, disembodied notion of time—were actually the product of efforts to solve a hugely concrete and worldly problem, the problem of longitude. Readers of Dava Sobel's popular book *Longitude* glimpsed a bit of that story: how the impecunious, self-taught loner named John Harrison succeeded where the great minds of the eighteenth century had failed, building a clock rugged enough to take to sea and accurate enough to maintain the time to within seconds over an extended voyage. This device mattered a great deal to a nation beginning to think of itself as the center of a global empire, because before it there was no reliable way for captains out of sight of land to say how far east or west they had gone. This led to unfortunate surprises.

The marine chronometer helped change all that. After setting the clock to tell Greenwich local time (that is, to keep track of the sun's position with respect to Greenwich), the navigator could sail away. When curious, he observed the local time wherever he ended up (by observing, say, the sun's position in the sky), and then compared it with Greenwich time as shown on the chronometer. The difference could be expressed in minutes, but those minutes of time implied a distance

in degrees. After all, the Earth sees the sun turn around the sky once in 24 hours; which is 360 degrees in 24 hours, or 15 degrees an hour. Is your chronometer one hour ahead of local time? You are 15 degrees west of Greenwich.

NOT THAT ANYONE had to use Greenwich. Longitude is a relative measure, so the choice was in this sense arbitrary, even if natural for Britain, given the status and the equipment of the Royal Observatory. Other countries used their own national observatories for most of the nineteenth century. In 1884, when delegates from twenty-five countries gathered at Washington, D.C. to try to settle on an international prime meridian, Greenwich was by no means a shoo-in. A newspaper in Louisville wanted to know why the United States should "concede to John Bull's dull Greenwich the position of time dictator? Now what is Greenwich to us? A dingy London suburb." The very idea repelled the French, and hence the Gallic representatives went on at length about the need for a "neutral" and "scientific" zero line for time and maps, rather than an embarrassingly "national" (and non-French) one.

The transcripts of the subsequent debates provide an engaging testimony to the entanglements of time, science, and abstraction. What was wanted was a neutral line, and at the same time a meaningful line, a line weighted with a landmark on the ground, and preferably also a line with some historical significance. How about the top of the pyramids? The British did not kindle to the idea, or to any of the others: the island of Ferro, the summit of Teneriffe, the Bering Strait. Anyway, the British delegates started to argue, what is neutral anyway? Nothing, not even units of measurement themselves. Consider the meter, pointed out the (pro-Greenwich) American delegate: it is French! These debates (which the British won) are interesting precisely because they offer a glimpse of how hard it was to take the profoundly abstracted concept of scientific time—neutral clock-time—and to fit it back onto the actual earth of dirt and water and history.

At the top of Greenwich hill I sat for a while and watched tourists try to do the same thing. The "real" prime meridian, used for the current system of Universal Time, is a statistical composite, an abstraction. So it no longer corresponds exactly to the line laid in the pavement in front of the observatory, a line that has been gussied up (a digital clock reading to hundredths of a second, a laser, a vending machine that imprints the current time on a souvenir certificate) into a sort of time-shrine. Yet this blurry fact is nowhere made clear enough to undermine people's enthusiasm as they confront this phantom boundary of time and space.

"OK, you get in the East, and I'll get in the West…" Photos followed. One small boy stood cautiously aside: "Now what do I do?" His father suggested he straddle the line. Panic, tears: "No! No!" People arranged themselves to step across the line in tandem, or sought to be photographed in "limbo," leaping above it. They stood on it as if it were a rhino, recently dropped on a strenuous safari. They set their watches, reading the inscriptions of the longitudinal distances to far-off cities: Colombo, Canberra, Port Stanley. One couple took off their shoes. In sum: people were orienting themselves.

It is a word charged with forgotten meanings. "Orientate," from the Latin *oriens*, or East, is a term derived from the participle of the verb "to rise." It comes down to us as the word for "figure out where you are" because of the medieval cartographic tradition of organizing world maps around Jerusalem. Yes, the East was where the sun rose, but Jerusalem was where Christ rose, and where his second coming was to be expected. In those highly schematic medieval TO maps (named thus because they look like a T inscribed in the letter O, and because those letters are the abbreviation for *Orbis Terrarum* or "earthly disk") spatial directions and Christian eschatology occupy the same ground. The garden of Eden and apocalyptic images often sit side by side on these maps, which are really cosmological diagrams. Indeed, one of the most significant places where such spatio-temporal cartographies can be found is in the most important tradition of apocalyptic interpretation in southern Europe, as illustrations in commentaries on the Book of Revelation compiled by an eighth-century Spanish monk called Beatus of Liébana. To find one's "place" in the European tradition has never been wholly separated from knowing where and when time begins and ends.

How durable were these ideas? Very durable. Shortly before the international meridian conference in 1884, a few visionary souls proposed pulling everything together by defining the new, global, scientific prime meridian as a line through Jerusalem (or Bethlehem). Their proposals did not get very far, but one can admire their fervid syncretism. After all, we date the era (awkwardly, and, it turns out, inaccurately), to an event that ostensibly occurred in Judea; and so each year, each day, they reasoned, ought to begin there.

The precision instruments of Greenwich prevailed, but the notion of a "birth" at the start of time still clings to the line. The strangest thing marking the secular time-shrine on the prime meridian in Greenwich is the sculpture placed at the edge of the observatory terrace. The steel construction stands about ten feet high and most closely resembles an enormous, shining gyroscope, set on an aerodynamic tilt to the north. The rakish axis has an indisputably phalloid air about it, as it juts out over the vista. And yet the artist, Christina Garcia, has balanced this celestial tool with an equally blatant cosmic yoni: two moon-like flanges of scimitar gleam and together create a mandala of void into which the "axis of space and time" can pass.

AS I TOOK this in (lamenting that the perennial gendering of linear and cyclical time had come to this), a small boy arrived on the scene, surveyed the form, and made a beeline for the origin of the universe, diving gleefully into the breach. One might see this as a reaction both natural and deeply grounded in history: parturitions, after all, lie at the origin of many a creation story, not least at the incipit of Christian time. Such travails turn up at its end as well. Probably the most ghoulish image in *The Apocalypse* is Matthias Gerung's mid-sixteenth-century woodcut entitled "The Birth of the Antichrist," which presents a full-frontal obstetric depiction of a claw-footed mother yielding the "son of perdition" to the light of day: he is being pulled from her body in a halo of flame by a pair of horrid little devils who have wedged their feet against the pudenda in order to get more purchase on their savior. Christian time, Gerung reminds us, begins and ends in a nativity.

The boy's father was inured to the larger mytho-theological significance of his son's enthusiasm, seized him, cuffed him, and returned him to his stroller. And this was fitting. Time, in the dominant European figuration, is most often depicted as a father—"father time," gray-bearded, stern, wise, ever ready to discipline ludic and sensual irruptions. Those aspects of time that looped about, like seasons, could be gendered as female, but the relentless time that marched ahead was an old man. Not that he was wholly sterile. According to a tidbit of Greek wisdom preserved by the second-century Roman jurist Aulus Gellius: *Veritas filia temporis*, "truth is the daughter of time."

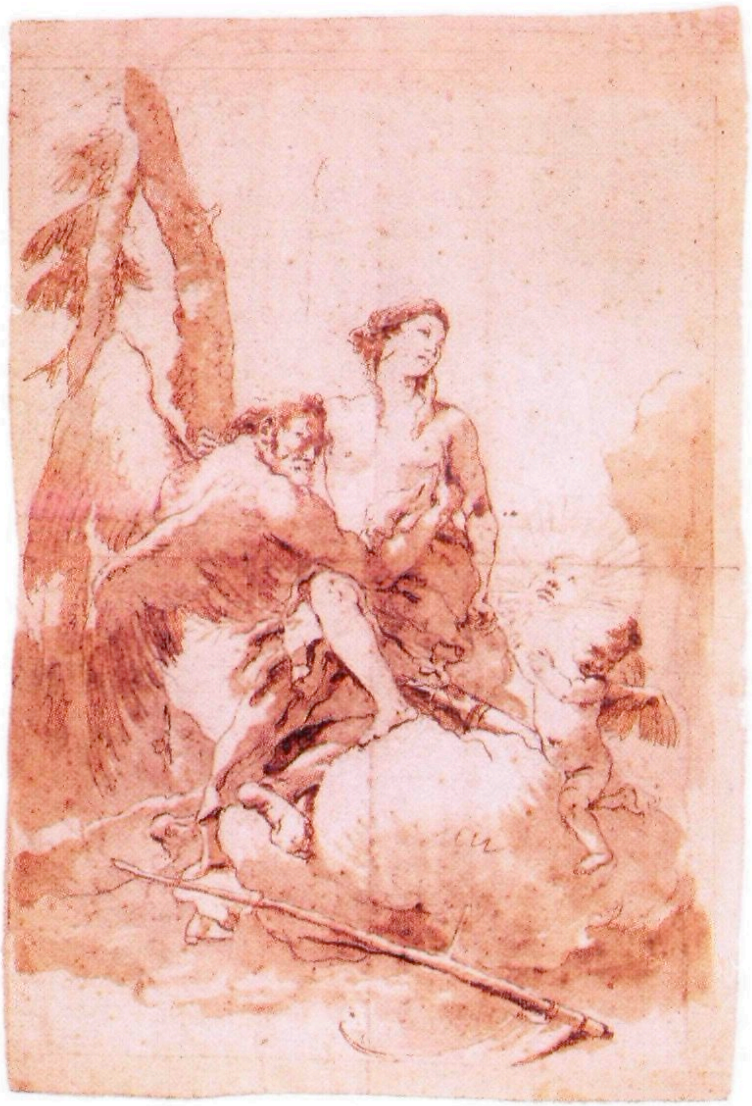
It was a formulation of great power, dear to the early church, rendered into allegorical paintings and sculpture in the Renaissance, and later secularized by the practitioners of the new sciences. In the middle of the eighteenth century, Giambattista Tiepolo made it the subject of an extraordinary ink sketch, called "Father Time Revealing Truth." In Tie-

polo's image, a heavy-winged old man, kneeling somewhat awkwardly, has his massive arms around the disrobed torso of a radiant young woman, whom he appears to be helping up onto a globe set into the clouds. A putto averts his face as he lifts a sun to shine on the scene. It will give some sense of the ambiguity of the scene to learn that the drawing was for a while mistakenly titled "Time Abducting Beauty." He may be revealing her, and putting her on top of the world, but he may be pulling her down, or carrying her off. He may be up to something else entirely.

Every once in a great while an image will seem to capture, in a few lines of sepia wash, the fullness of what thought can offer. "Father Time Revealing Truth" has that power. The portrayal of truth as the offspring of time does more than simply invoke a kind of straightforward intellectual optimism—the hope that the truth will out, eventually. It also expresses the subtle idea that absolute truth must, somehow, be beyond time, external to it. Now here is a deep notion. When we speak of "the truth," we seem to be speaking of something beyond corruption, outside of change, something not subject to time. The "truth" always seems to mean things seen *sub specie aeternitatis*, from an eternal point of regard.

Perhaps it is possible to come up with a concept of truth that does not imply a concept of eternity, but it would be a much less familiar notion than the way Plato spoke of the truth in his timeless realm of forms, or the way Dante depicted meeting God in the final canto of *Paradiso*, or even the sort of truth sought by the scientist interested in "eternal laws." This is a strange thing, because no one, as far as we know, has been outside of time and returned to tell us how things appeared. And yet, again and again in the West "truth" works out to imply "true forever," "true beyond time." In this odd way, different theories of knowledge each contain, however hidden, different theories of the end and edges of time. Think of epistemology as the Trojan Horse that smuggles eschatology through the gates.

Tiepolo's drawing depicts this. Here is an iconography of the way to truth that at the same time portends destruction. He will raise her, and he will devour her. Was there ever a difference? Suddenly things made sense. The passing of time is death; the passing of time is truth. What follows? If time is death and time is truth, then truth is death. And here, finally, lies the enduring power of the apocalypse: the ultimate truth and the ultimate destruction come together. The word itself, notably, comes from the Greek term for "the unveiling."



Giumbattista Tiepelo, "Father Time Revealing Truth," c. 1755-60

It was in this way that the seventeenth-century English mathematician Joseph Mede read his Book of Revelation: he used it as a tool for understanding the world around him, and he deployed his geometrical sensibilities when it came time to fit the text to life, doing an intricate compass-construction diagram of "The Ende" to illustrate his book, *The Key of the Revelation*. This was not occultism, this was rationalism, and it inspired Newton's later work on the Apocalypse and the Book of Daniel. Did Newton think of this work as distinct in method or truthfulness from his investigations into celestial mechanics? Not at all. Of apocalyptic truth he wrote that a "naturalle man . . . might perceive the strength of it with as much perspicuity and certainty as he can a demonstration in Euclide."

Time, destruction, truth. The early modern period saw a vogue for *memento mori* watches—pocket timekeepers in the shapes of skulls, sometimes festooned with biblical imagery. There may seem something quaint about the way that the early clockmakers tried to hold together these elements that we now, for the most part, think of as easily separable. Time is an abstract flowing, free, in itself, from any particular significance, monitored by maniacally precise scientific instruments that are also without symbolic import. That is the truth. Destruction is unrelated. Greenwich Mean Time ticks on, announced by the familiar sound of the "six pips" at the hour, on BBC radio. These beeps are the transmission of time only. They are not meant to invoke the six pips that Persephone consumed in Hades, the six pomegranate seeds that bound her to the realm of the dead. The six pips are just a ticking sound in Greenwich; this is scientific timekeeping.

And yet, time and death still tap in step. In one of the middle rooms of "The Story of Time" sits a gray metal box about the size of an apple. It is considerably less visually interesting than the Breguet double-pendulum long-case regulator that ticks with breathtaking beauty beside it. This gray box is the timing device from a "chevaline" nuclear warhead, a timekeeper meticulously designed by some of our finest minds to ensure that a Polaris missile would detonate just above ground level, maximizing thermonuclear devastation. A fallen angel from the world of astronomy, indeed. The science of time has not yet brought us the perfect detonator, but it has brought us the best ones we have, and they are very good indeed. Conrad's Professor would be proud. ■