Calendar, Clock, Tower

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What is time? asked Saint Augustine. He rightly considered this to be one of the great religious questions. His brilliant analysis did not quite solve the puzzle--but then, no one else has done better before or since. Whatever time is, clocks and calendars measure, control, and constitute it. Towers are related media--time-heralds that claim dominion over space via sight and sound. These media--so fundamental that they are sometimes are not seen as media at all--negotiate heaven and earth, nature and culture, cosmic and social organization and define our basic orientation to time and space. As such, they are among the most profound media of political and religious power and control. Their analysis points to: 1) the relevance of old media for understanding so-called new media and 2) the importance of the logistical or organizational role of media.

Calendar

Calendrical systems are abstract devices of cognitive, political, and religious organization. They are among the most basic of all human sense-making devices. Like the more elaborate institutions of science and religion they render the cosmos intelligible for human use, only on a quotidian scale. Calendars are designed to coordinate periodic astronomical events (years, solstices, phases of the moon, days, etc.) with periodic human events (commemorations, anniversaries, holidays, sabbaths, etc.). The double job of calendars--to bind earthly history to celestial cycles--gives them their particular potency as media of communication. They are at once modes of representation and instruments of intervention: they constitute time in describing it. Calendars negotiate between the heavens and the state, and orient us to time and eternity. Their basic unit is the year, as the basic unit of the clock is the day. Both devices mimic, with imperfect precision, the motions of the heavens and earth and thus fulfill, even in a secular world, the classic religious function of providing a meaningful orientation to the universe.

Time-keeping is in some ways inherent to life itself. Life as we know it evolved on a planet having a daily rotation. The basic pulse of alternating day and night seems at some level to be built into all living beings. Oysters, potatoes, fruit flies, and bees--among many other creatures--can track the sun, locate themselves in geomagnetic fields, or consume oxygen in accordance with ancient daily rhythms (Aveni 1994, ch. 1). These remarkable acts of geocosmic orientation take place at a pre-cognitive level. Likewise, the menstrual cycle among humans or the seasonal migrations of birds, fish, and monarch butterflies are all

achieved without the aid of conscious calendar-keeping. Though the internal time sense can be thrown off if organisms are deprived of environmental cues about time (so-called "zeitgebers"), there is no question that life itself is periodic, a nest of overlapping cycles.

The human avidity for time-keeping is likely coextensive with human culture as such. Hunting and gathering, pastoral nomadism, and agriculture all depend on close observation of natural cycles, and humans had surely accumulated a wealth of oral lore coordinating plants, animal migration, and seedtime and harvest with the cycles of the sun, moon, and zodiac long before literate and numerate calendar-keeping came into play (Aveni 1994, ch. 2). More formal calendars require advanced knowledge of astronomy, and are key ingredients of civilization together with writing, mathematics, the division of labor, and centralized religious or state power. Two natural facts--the diurnal rotation of the earth and the annual orbit of the earth about the sun--shape all calendrical systems, and the monthly cycle of the moon is found in most. Other resources include solstices and equinoxes, even eclipses and comets. Much of the motivation of early calendar-making was the religious and political desire to synchronize everyday life to the motions of the celestial spheres--to do consciously what potatoes and oysters do instinctively.

Though all calendars have the day and the year, determining what each precisely is turns out to be deceptively difficult. Most of us think it takes the earth 24 hours to rotate on its axis. Not so. The sun does take 24 hours to return to a point intersecting the meridian, an imaginary north-south line that bisects the sky into eastern and western halves: this is the "solar day." Yet for the sun to make a complete circuit, the earth, since it is advancing in its orbit, must actually rotate about 361degrees to catch up to where it was yesterday with respect to the sun, which takes around an extra four minutes on average (but with a much wider range than that). The absolute rotation of the earth (the "sidereal day") currently takes 23 hours, 56 minutes, and 4.09 seconds. The earth's spin is slowing gradually thanks to the friction of the atmosphere and the oceans, necessitating, for instance, an additional second now and then, and 500 million years ago there may have been more than 400 days per year according to evidence from growth rings in fossilized mollusks and coral. (The moon's rotation also appears to have once been faster, with a month of about 28 days.) There is likewise no universal standard of when the day begins, and options include sunrise, noon, sunset, or more artificial standards such as our midnight. Nothing is so "everyday" as a day, but it is an entity readily deconstructed as a work of cultural approximation and averaging.

Determining the length of the year is even more complicated (Richards 1999; Steel 2000). The Babylonians reckoned the year around 360 days, and thus chose 360 as the number of degrees in a circle

(thanks also to its easy divisibility by 2, 3, 4, 5 and their multiples). Our symbol for "degree," a raised "o," comes from the Babylonian symbol for "sun." Around two thousand years ago in Egypt, Babylon, China, and Greece, it was known that the year takes 365 days and a fraction. The calendar implemented in the reign of Julius Caesar--named "Julian" in his honor--introduced a leap year every four years, putting 365.25 days in the year. (In fact the earth takes 365.24219 mean solar days to orbit the sun). The Julian calendar, which ignored the lunar cycle in contrast to most other systems, was good to within 11minutes/year. But small differences add up, and the Julian calendar lost a day about every 128 years. By 1582, when Pope Gregory XIII introduced the Gregorian calendar, which omits three leap years every four hundred years, the calendar was about 12 days off. Protestant countries resisted the change for the predictable religious and political reason of not wanting to be seen as taking orders from the Vatican. After 170 years of confusion in dealings with France and the continent, England and its colonies finally made the switch in 1752. Englishmen went to bed on Wednesday 2 September and woke up on Thursday 14 September. Rumors of calendar riots have been greatly exaggerated (Poole 1995). Russia (like Greece and Turkey) did not switch until the twentieth century, with the result that the "October Revolution" of 1917 took place in what we now call November.

The first item printed by Gutenberg was a calendar, that is, an almanac. The Bible came later. Calendars may be as religiously important as scripture. Every religion has a calendar. Jews, Buddhists, Jains, Muslims, Hindus, and Baha'is each have their own. Christianity has at least three, and Roman Catholics, Eastern Orthodox, and Armenian Orthodox can still end up celebrating Christmas on different dates. The chief motive of Gregory's reforms was to keep Easter, the most important of the Christian "moveable feasts," from drifting too late into the springtime. In contrast to Christmas, which always falls on 25 December regardless of the day of the week, Easter always falls on a Sunday, varying widely from year to year (22 March to 25 April are its theoretical limits). The current definition--the first Sunday after the first full moon after the vernal equinox--was set in the Council at Nicea in 325 CE after long disputes among early Christians. It is a remarkably messy definition since it requires specifications of the (1) human week, (2) lunar cycle, and (3) solar cycle. But the definition succeeded in its overt sociological purpose: to find a date for Easter that would never coincide with the Jewish Passover. The Nicean Council thus drove a further wedge between Christians and Jews and also disciplined Christian schismatics such as the Quartodecimans ("fourteenthers") who continued to celebrate Easter on the 14th day of Nisan, the date of Passover in the Jewish Calendar. Ironically enough, the Christians had to revert to the lunisolar logic of the Jewish calendar--otherwise foreign to their Roman-Julian tradition--to prevent Easter from matching Passover. In a classic act

of repression, Christians fought the foe by internalizing the foe's logic. Calendars are never neutral maps: people signal religious allegiance and identity by the holidays (holy days) they observe (Zerubavel 1982).

The Jewish calendar is of particular interest. Their scripture starts with an account of the creation of the world in which one of the very first items created was the day itself--which is characteristically defined in the Hebrew style as starting in the evening (Gen. 1:5). Moreover, the book of Genesis gives divine sanction to the seven-day week, culminating in the Sabbath or day of rest. Sabbath observance has always been one of the key markers of Jewish identity, as are high holidays such as Yom Kippur (Day of Atonement), Pesach (Passover) and Rosh ha-Shanah (New Year's), which are also considered Sabbaths, though they may fall on other days of the week besides the seventh. Sabbath observance is perhaps the most intense form of calendrical religiosity. Seventh-day Adventists make an interpretation of the calendar into an article of faith.

The Jews borrowed a lunisolar calendar from the Babylonians, and after diverse refinements, have a calendar that slips about 6 minutes/year or one day every 216 years. A lunisolar calendar uses both the phases of the moon and the sun. The Muslim calendar, in contrast, is strictly lunar, with a year of either 354 or 355 days made of 12 lunar months. It makes one complete rotation through all the seasons once every 32 Muslim years. Its first year is 622 CE on the Gregorian calendar and it uses the abbreviation AH ("anno hegirae," in the year of the hegira). Since the Muslim year goes faster, one cannot find its equivalent in the Gregorian calendar by subtracting 622. Doing so would yield a date that is yet to come on the Muslim calendar. Eventually the Muslim calendar will catch up with and pass the Gregorian calendar.

Another historical feature of the Jewish calendar is of general relevance: its governance by central authority. After the destruction of the Second Temple in 70 CE, the diaspora calendar was coordinated by remote control by signal flares and messengers from the Sanhedrin in Jerusalem, which maintained a monopoly control on sighting the new moon and thus declaring the start of the new month. In an era before electric telecommunication, the slow movement of such time-sensitive data was a major inconvenience, and Hillel II ended Jerusalem's monopoly in 356 CE, allowing each Jewish community to determine the new moon. A clear principle in the history of calendar-making is that those in power make the calendar. A key sign of sovereignty is the power to declare a holiday. Astrological prognostications have often served as ideological supports for the rulers. Among the Aztecs, for instance, a priestly class maintained a complex dual calendar of 260- and 365-day years nested within 52 year cycles of the 365-day year (or 73 years of 260-days). Indeed, calendars have always been under the control of priestly classes who serve the powers that be.

Every calendar accordingly invites resistance. The Qumran sectaries of the Dead Scrolls, for instance, hated the lunisolar calendar imposed by their Greek conquerors and observed instead what they called "true calendar." Observing the Sabbath has always been a form of resistance to state and market power (Carey 1989). Celebrating the Sabbath on the eighth instead of the seventh day enabled early Christians not only to commemorate the Resurrection but also to distinguish themselves from Jews. The ancient Jews, for their part, seem to have made Saturday the last day of the week to avenge their Egyptian captors, who venerated Saturday as the first day. Contemporary Jews and others in turn sometimes resist the Christianity of the calendar by preferring the designation BCE ("before the common era") instead of BC ("before Christ") and CE ("the common era") instead of AD ("anno domini"--in the year of the Lord). Quakers traditionally call the days of the week by ordinal numbers (e.g. Sunday is "first day") to avoid honoring the pagan gods (the seven moving heavenly bodies) whose names the inherited Roman calendar attaches to days of the week--Sun, Moon, Mars, Mercury, Jupiter, Venus, and Saturn. This legacy is clear in the English Saturday, Sunday, and Monday but obscured for the other days of the week because they take their names from the Germanic versions of the same gods; it is clearer in most Romance languages.

Like all systems of nomenclature, calendars can yield instances of delicious arbitrariness. Consider again the weekdays. In modern Greek, for instance, Sunday is "the Lord's Day," Monday is "second day," and Tuesday is "third day," and so on to Friday, which is "preparation day" (presumably for the Sabbath); in Russian, in contrast, Sunday is "Resurrection Day," Monday is, splendidly, "the day after not working," Tuesday is "second day," Wednesday is "middle" (like the German Mittwoch), Thursday is "fourth day," and Friday is "fifth day." Obviously the Greeks and Russians start counting in a different place, though they both call Saturday "Sabbath." Indeed, when the week ends and starts is as arbitrary as when the day does. The modern weekend is a composite of the seventh and the first day, though to many of us Monday feels like the first day of the week. Months have a similar arbitrary quality: how many of us readily remember which months have thirty days and which have thirty-one?

Most calendars possess a deep cultural conservatism--appropriately enough for media that store time. Quirks of the Roman world live on in the twenty-first century. July and August, formerly Quintilis ("fifth") and Sextilis ("sixth"), owe their names to the vanity of two men dead for nearly two thousand years, Julius Caesar and Caesar Augustus. We call our ninth, tenth, eleventh, and twelfth months September, October, November, and December, which of course mean seventh, eighth, ninth, and tenth. The calendar gods have a sense of humor. The idea that the course of history has a middle point, with a negative direction

(before Christ) and a positive one (after his birth), is obviously of Christian origin. The hitch is that when Christian monks figured out this dating, they did not possess the notation or concept of a zero, which leaves us with 1 BC skipping to 1 AD--the reason why purists claimed the new millennium began in 2001, not 2000, which would have been only 1999 years after Christ's putative birthdate. The modern world operates on top of an ancient calendrical infrastructure.

Modern reformers sometimes sought to strip away the calendar's accumulated religious content. The French Revolution tried to institute a ten-day week (like that of the ancient Greeks). The Republicans converted the twenty four hours into ten, each hour subdivided by 100 minutes, and each hour subdivided into 100 seconds; they brought to the calendar the same decimal zeal that led to the metric system of weights and measures, though with less success. The Republicans wanted to weaken the grip of religious holidays and the Sabbath, replacing holidays celebrating saints, for instance, with notables from the history of reason. They also wanted people to work more and take fewer holidays. Napoleon abolished the revolutionary calendar in 1806, doubtless to widespread relief. In a similar spirit, the early Soviet Union experimented with a five-day week for about a decade, and then gave up. The grip of the seven-day circle is tenacious (Zerubavel 1985); some things even the French and Russian revolutions could not change. Every religion may have its calendar, but every calendar probably has its religion as well, if even the religion of secular reason. As constructs that synchronize earth and heaven, culture and nature, and the periodic events of history and astronomy, calendars remain among the oldest and most important of all religious media of communication.

Clock

As time-keepers, clocks resemble calendars in some ways. In a sense, clocks are fast calendars and calendars are slow clocks. Calendars model time on a macro scale, starting with the day, and aggregate upward to weeks, months, seasons, years, decades, centuries, and indefinitely larger units (the Hindu "kalpa," perhaps the largest cycle in human calendars, takes 4,320,000,000 solar years); clocks generally model time on a micro scale, starting with the day, and subdivide downward to hours, minutes, and seconds according to the sexagesimal system and then, switching to the decimal system, to milliseconds and indefinitely smaller units (a "yoctosecond" is one septillionth of a second, or 10 to the minus 24^{th}).

It is easy to exaggerate the differences of the two media of time-keeping, each of which has plenty of internal diversity. There is, for instance, the doomsday clock, which indicates our presumed proximity to thermonuclear apocalypse, and "the clock of the long now" which is designed to run for ten thousand years

(Brand 1999). Even so, there is an important difference. Calendars deal in what the Greeks called chronos, time as duration or span; clocks deal in kairos, time as moment or point. Calendars are chronic, clocks are acute. As a rule, clocks indicate the immediate moment, but lack memory or foresight. Curious automata, strange little personae with their "faces" and "hands," clocks say the same thing over and over again, and yet the information they provide is always fresh. They tell you where the "now" falls in the day. In this locating function clocks do for time what compasses, sextants, and GPS devices do for space. They are compasses whose needle points to the now rather than to the north. While it is true that calendar-observatories like Stonehenge or astrolabes can locate you on the calendar, most calendar systems do not provide such data intrinsically; instead you have to find the "you are here" spot by other means. While clocks provide ever fresh data--which is paradoxically always the same message: "it is now"--calendars store and extrapolate data, thanks to their cyclical character. Calendars are literally event-ful, but clocks are relatively barren, their intelligence being used up every moment. (When someone asked Yogi Berra "Do you have the time?" his retort was supposedly: "You mean right now?") Calendars preserve past time and project future time. As compass is to map, so clock is to calendar. Clocks are ultimately pointers of celestial position and today are governed by astronomical calculation.

The clock is relatively recent among historical time-keeping devices. The hourglass, for instance, is ancient: long used at sea, it lives on in board games. Clepsydrae (water-clocks) were in use in Egypt and Babylon by 1600 BCE. A chief kind of clepsydra in Greece was a container with holes that, when filled with water, took a set time to drain. The sundial is also ancient, but it traces a longer time-span (all daylight) than either the hourglass or the clepsydra, and has direct legacies for the clock. One is clockwise rotation: in the northern hemisphere, the shadow on a sundial moves from west to north to east, and this motion was retained for the hands on mechanical clocks. (The morning hours on a clock face, 6 to 12, indicate that the sun is in the east, and the afternoon hours of 12 to 6 that it is in the west.) Another legacy is the dial itself: from the Latin word dies (day), a dial is a readout divided into twelve hours, a division of the day that started in ancient Egypt around 2100 BCE and may have something to do with the 12 parts of the zodiac. (An even remoter legacy may be the twelve-fold touchtone telephone dial today.) It has long been customary to adorn sundials with lapidary mottos about the fleetingness of time such as "ultima multis" (the last day for many) or "lente hora, celeriter anni" (slowly the hour, quickly the years), and sometimes sundials were mounted on gravestones. All time-keeping devices implicate questions of time and eternity.

The word clock derives from the Latin cloca, and is related to the French cloche and the German Glocke, all of which mean bell, and the clock as we know it first emerged in late medieval European clock towers. Bells started to be used throughout Europe in the twelfth century, and as large mechanical clocks developed around the fourteenth century, they took their place in church towers, creating a communications center at the heart of many towns. Bells were not mere time-keepers; they were among the central media of religious and civic communication in late medieval and early modern Europe. Bells were located in either church steeples or municipally owned towers, often with custody battles between church and state (see more on bells below). Again we see the truism in the history of time-keeping that whoever sets the time controls the society. Today the state has won decisive control over the time, or to be more precise, the military, as in the U. S. Naval Observatory, which sets the official time in the United States. Physicists are the new priests.

The modern clock is distinct from previous time-keepers in that it has both a counter and a periodic motion or oscillator. Clocks are data-processors. Unlike a metronome, which has a regular beat but says nothing cumulative, clocks interpret the time. The clock is one of the most essential media of the modern world. The minute hand, which started to be used in the sixteenth century, only became practical after Huygens perfected the pendulum in 1656, and the second hand followed by the end of the seventeenth century. It is difficult for us to imagine a world without a minute or second hand. (This is the world we moderns seek on vacation.) In Olympic sports, hundredths of seconds are routinely used, and much scientific investigation depends on increasingly fine subdivisions of time. All units of time from milliseconds down are now being colonized by science. There is lots of room at the bottom (Dyson 1997, ch. 10).

The clock, argued Lewis Mumford (1934), was the key technological invention of industrial society--even more than the steam engine. The clock is power machine whose achievement is not principally in tracking minutes and hours but in coordinating the cumulative actions of people. As clocks grew smaller and more personal, they became ubiquitous on wrists, telephones, computers, cars, and ovens, among many other devices. Clocks are at the heart of media convergence today. Every new device, from I-pods to cell phones, has a clock in it--meaning that its ubiquity on wrists seems to be disappearing. (Three quarters of my undergraduate class at the University of Iowa in fall 2008 did not own a watch; they used their cell phones instead.) Though the transition from the medieval bell to the modern wrist watch witnessed the loss of a ceremonial function for time-keeping, clocks provide the grid on which our world operates. The clock, unlike the sundial, ticks away regardless of sun or cloud, human want or need. When we say “o’clock” we mean that we are following clock, not astronomical, time.

The historical process by which time-keeping shifted its focus from the natural world to a more abstract system of quantitative constants culminated in the twentieth century. For thousands of years, astronomers set the time. In the mid twentieth century time-keeping duties shifted to physicists, completing the long slow abstraction of time from the natural cycles. A universal measure of mass and length (the gram and the meter) was more or less settled by 1800; one for time was made official only in 1967 when the second was defined as 9,192,631,770 oscillations of the cesium atom (Jones 2000). The standardization of weights and measures began in the French revolution; it took more than a century and a half to achieve such for time.

The clock's origins in Europe were largely religious: the need of monks to observe the canonical hours of prayer. In eleventh-century China, in contrast, where horology was much more advanced than Europe and the first mechanical (water-powered) clocks were developed, the main context for time-keeping was political. The emperor's power was bound up with his declaration of holidays and calendars since he was supposed to operate in tune with nature according to the "mandate of heaven." For debated historical reasons, advancements in Chinese clock technology stagnated, and Europe became the world leader in clock technology from the late thirteenth century onward (Landes 2000).

Since eighteenth-century Europe, the modern clock's chief motive has been neither religious nor political but economic: in Ben Franklin's words, "time is money." Critics of industrial capitalism ranging from Karl Marx to Charlie Chaplin have seen the clock's strict time-discipline as a cruel distortion of human existence (Thompson 1967). Deists in the eighteenth century found in the clock's indifferent but constant mechanism a model for the universe: God had wound it up in the beginning and now was letting it run down without further supervision. Poets found something melancholy in clocks, as in Robert Frost's haunting lines:

> And further still at an unearthly height
> One luminary clock against the sky
> Proclaimed the time was neither wrong nor right.
> I have been one acquainted with the night.

For Frances Cornford (Darwin's granddaughter), the watch spoke a death wish (read it aloud):

> I thought it said in every tick:
> I am so sick, so sick, so sick.
> O death, come quick, come quick, come quick,
> Come quick, come quick, come quick, come quick!

No one who wants to be part of the modern world can defy the clock's incessant beat. It is a prime symbol of modernity, of our Faustian mortgage of ourselves to things we did not choose but will not give up. The clock helped integrate the world spatially, creating the grid necessary for global transportation and communication. The synchronization of remote clocks answered the problem of calculating the longitude at sea: British clockmaker John Harrison, by creating a clock so accurate that one could know the precise time in England even on a ship in the middle of the Atlantic, made it possible to reckon precise location on an east-west axis (Sobel 1995). A sextant can measure the latitude, and the time difference in the local sunrise at the ship from the London clock time yields data sufficient to pinpoint the ship's location on the earth. "Minutes" and "seconds," of course, are not only intervals of time but angular measurements of distances on the surface of the earth. The need for a standard time shared between distant places first emerged at sea, well before the telegraph made it possible and the railroad made it necessary (Carey 1989).

Prior to the railroad and telegraph, every town set its noon hour by the shortest shadow. It did not matter if Dover, Brighton, Portsmouth, Plymouth, and Penzance, for instance, stretching from east to west along the southern coast of England, each had a successively later noon hour. By the mid nineteenth century, the crazy quilt of local times in industrializing countries was causing serious problems in railroad traffic, and diverse nation-states sought to synchronize to a single clock. England is an instructive example (Howse 1980). At the Greenwich Observatory in 1833, a leather ball was first dropped down a pole at 1:00 p.m. to serve as a visual signal to ships on the River Thames to set their watches by Greenwich mean time (GMT). GMT was first distributed by telegraph within the nation in 1852, and by the late 1850s, the country was covered with a network of time balls, cannons, bells, and needles to spread the news of when exactly 1:00 p.m. was (GMT did not become the official national time until 1880). By 1848 already Dickens observed the drift away from natural zeitgebers: "There was even railway time observed in clocks, as if the sun itself had given in." Time coordination on air followed that on wire. In 1924, the BBC started its six pips signal on the hour, followed in 1936 by a speaking clock service. All radio and television programming remained intensely gridded into national and regional time schedules until the early twenty-first century.

Internationally, the current grid of time zones, centered on Greenwich, was determined in 1884. Establishing a world clock was easier than a world calendar, which still does not exist, but there are still small pockets of resistance and variance to the world clock. China, a country with a huge east-west spread, has a single time zone; Iran, Afghanistan, and India start on the half hour and Nepal on the ¾ hour, etc. In 2007 President Hugo Chávez of Venezuela changed his country's time zone by 30 minutes, treating sunlight as yet

another item to be redistributed among the people. Standard time is a sine qua non for international capitalism today--perhaps one reason Chávez opted out. In 1998 the Swiss clock company Swatch proposed a new base-ten system of internet time which transcends time zones, without much lasting impact (the new meridian passes, with suspicious convenience, through Swatch headquarters in Switzerland).

An earlier, and more profound, examination of standard time took place in the same country in 1905. A young patent clerk discovered the principle of special relativity while daily inspecting designs for telegraphically synchronized remote clocks. Albert Einstein wondered, in essence, if standard time is possible on a cosmic scale. Noting the finite speed of light, he concluded that there can be no universal clock, no absolute "now" valid for all points, a revolutionary insight whose consequences range from quantum mechanics to cosmology, art to theology (Galison 2003). The same means (trains and telegraphs) that brought us standard time on earth revealed its impossibility in the universe. Einstein proved Augustine's point that time seems obvious until you ask what it is. Time may be media's central object (Krämer 2006); the same might be said of religion.

Tower

From the Tower of Babel to the World Trade Center buildings toppled on September 11th, 2001, towers have long been symbols of communication. They have also been targets of resentment (by God in the first case and al-Qaeda in the second) of efforts to extend dominion over space. Like calendars and clocks, towers mediate between heaven and earth: they point upward to the sky, but thereby gain more advantage over the earth's surface. Towers are uniquely associated with divine and secular power. Like temples, they mark the binding point of heaven and earth, the axis mundi. They are artificial mountains, often built on top of preexisting heights. Every tower implies a network of communication.

The key fact about towers is leverage. Give me a place to stand and I will move the earth, boasted Archimedes. Towers provide such a point optically and acoustically. Every unit of increase on the vertical axis enormously multiplies the reach of the horizontal axis, thanks to both the principles of trigonometry and the curvature of the earth. The "Babel complex" (Barthes 1993: 1385) that fires our ambition to scale the heavens has a sideways, earthly payoff. A tower is an optical fulcrum, providing mechanical advantage for the eye and favorable acoustics for the ear. Towers are power technologies par excellence, and thus have always been key relays in networks. The leverage they offer is threefold: seeing, being seen, and being heard. Let us take each in turn.

First, towers extend the range of vision. They suppress space and extend the horizon. Viewers on towers have a natural telescopic advantage. Towers are privileged spots from which to observe happenings above and below. Indeed, like ancient temples, they are observatories in the strict sense, places for auguring celestial and terrestrial signs. They set the time and date. (It is atop a turret in the castle that Hamlet declares: "the time is out of joint.") As the tower is the classic place to conduct a watch or vigil, it retains a potent hold on the religious imagination. The Watchtower is the publication of the Jehovah's Witnesses, a name evoking biblical imagery of military surveillance, evangelical warning, and millennial expectation. According to Vitruvius, the Roman architectural theorist, temples to the gods who protect the city such as Jupiter, Juno, or Minerva should be built at the highest point possible, so as to oversee the city walls. In the Greek and Roman worlds, such temples linked worship, civic festivals, and military reconnaissance. The Athenian acropolis, for instance, was at once an awe-arousing device, an instrument of tax collection, and a fortification. The Bible expresses similar views: "The name of the Lord is a strong tower," says Proverbs 18:10. Yet two biblical towers are also symbols of futility: the Tower of Babel and the tower whose cost you must count in advance, lest you start to build and can't finish (Luke 14:28).

Towers are the fundamental media of surveillance, which explains their long history of military use as posts for sentinels and guards (Bentham's Panopticon had a tower at its center) and launch pads for projectile weaponry (stones, molten lead, arrows, guns, and artillery). The discovery of the vanishing point in fifteenth-century painting in Italy and Flanders might owe something to the points of view rendered by towers and ramparts. The great painter Albrecht Dürer wrote a treatise on fortresses, the Befestigungslehre (1527), in which the linkage of ballistics, early modern optics, Renaissance art, and military surveillance from secure positions is crystal clear. Renaissance perspective and artillery both arose in the fifteenth century; both depended on the analysis of straight sight lines from a central point (Kittler 2002). To see is to draw is to design is to target is to fire: this sense of armed vision continues in ordinary talk of shooting pictures today. (A look can be a projectile weapon.) Orhan Pamuk attributes a similar revolution in Muslim miniature painting to a tower's eye view: Ibn Shakir, the legendary calligrapher in Baghdad, witnessed the city's destruction by the Mongols while he was hidden in the top of a minaret and drew it while he could, leading to a revolutionary new depiction of the horizon line from "an elevated Godlike position" (Pamuk 2001: 70).

Second, towers not only allow seeing at a distance: they are also easily seen from a distance. They are often among the most visible objects on any horizon. Towers are always designed to be looked at and are often exercises in conspicuous expenditure. (The phallic dimension is too obvious to dwell on.) The tallest

building in any city usually says something about the city's character. Towers often are synecdoches for a city. In Kiev, Ukraine, the Rodina Mat, a socialist-realist monstrosity that looks like a metallic Green Giantess, was supposedly designed to be just slightly shorter than the tower of the Lavra monastery, which sits behind it on a hill and marks the symbolically laden birthplace of Russian Orthodoxy. Modernity's most important tower, the Eiffel Tower, is certainly symbolic of its city. Guy de Maupassant, who detested the tower, liked to breakfast at a restaurant at its base--since, said he, it was the only place in Paris you didn't have to look at it. The Eiffel Tower has long been a platform for publicity and advertising, being decorated at times with a large clock (of course) and as a giant thermometer. Once it was hung with lights that spelled CITROEN; the Nazis in 1940, with a less developed eye for line, hung a horizontal banner on it announcing "Deutschland siegt auf alle Fronten." More recently, the Eiffel Tower served as a beacon of the countdown to the year 2000, a huge digital readout announcing the remaining days of the millennium down to the second. Towers signal not only civic identity but convey vital intelligence (such as Paul Revere's lanterns), weather, news, and above all, the time. As magnets for public attention, towers dictate, to at least some degree, public space and time.

These two sorts of leverage--vision and visibility--work together. Roland Barthes calls the Eiffel Tower "an object that sees, and a gaze that is seen." It transgresses "the ordinary divorce of seeing and being seen. It achieves a sovereign traffic between the two functions: it is a complete object which unites, if one may put it thus, the two genders of the gaze" (Barthes 1993: 1384). Uniting "masculine" vision with "feminine" visibility is of course not unique to the Eiffel Tower; it is characteristic of all towers.

This ease of sending and reception makes them essential media for line-of-sight communication, such as signal fires in antiquity and modern optical telegraphy. Aeschylus' Agamemnon famously begins with a primal scene of communication at a distance: Queen Clytemnestra divining the fall of Troy via a system of signal fires linking Troy to Argos. (The play opens with a bored watchman on a tower, tired of waiting for a signal to appear, who jubilantly at long last spots a flickering light on the horizon.) The ancient Greeks certainly did use hilltop signal pyres and the one described by Aeschylus is possible but unlikely, as its bonfires would have to be over 24m high to be seen at the distances mentioned (Aschoff 1989, ch. 3). The optical telegraph developed in late eighteenth-century France falls in this lineage of line-of-sight tower-to-tower communication. Paris could connect to Strasbourg near the German border within 36 minutes. By the 1840s, there were over 3000 miles of optical telegraphs in France, all operated by the war department, which had the aim of creating an "espace nationale" or integrated national community (Flichy 1991). Cities with a

"beacon hill" preserve this communicative function of the tower. Towers always establish lines of communication, real or symbolic, that otherwise would not exist.

Third, towers are acoustic devices that enhance the propagation of sound. Carillons, minarets, pulpits, and broadcast antennas all show that a small vertical investment yields major circumferential dividends. Towers and turrets have always been used for proclamations and decrees. Lighthouses--with their searchlights, radio communication, and foghorns--unite all three functions of the tower perfectly.

In European history bells are the key historic acoustic media connected with towers. Bells are key proclaimers of the Christian calendar of Easter, Christmas, and other holidays. They are major time-keepers and day-shapers. In nineteenth-century rural France, for instance, bells summoned people to mass, weddings, funerals, emergencies, assembly or battle, and often rang with a distinctive dialect unique to each village (Corbin 1998). Similar practices took place earlier and elsewhere in Europe. One of the main functions of bells is mobilizing bodies into assembly--either soldiers to battle or Christian soldiers to church. Indeed, bells are a specifically Christian institution and Longfellow's phrase about "the belfries of all Christendom" has sound comparative religious footing. The Muslim rulers of the Ottoman empire, for instance, prohibited the ringing of church bells in conquered areas, properly recognizing the great communicative and mobilizing force these media can hold for Christians. Like Islam, Judaism has no tradition of bell-ringing for religious or chronometric purposes; the shofar or ram's horn is used for ushering in the new year. (Amos Oz [2004: 191] reports that his Aunt Sonia, growing up in Poland in the early twentieth century, found the sound of church bells scary, the signal of a pogrom). In the Philippines, the Spanish conquistadores ceremonially placed native populations "bajo las campanas"--under the bells. Once people could hear the church bells, they were Spanish subjects. Sound defined the space of the crown's dominion. To hear the bells was to acknowledge Spanish sovereignty. Audition was assent--or at least conscription. (Here is the ancient link of hearing and hearkening, listening and obedience.)

Bells demarcate a space of local identity, allegiance, and belonging. In Italian, "campanilismo" (lit. bell-tower-ism) means parochialism, as does the French term "de clocher." To be a true Cockney, as the old saying goes, one must be born within the sound of Bow Bells--the church called St. Mary-le-Bow in London's East End. The BBC's signature sound for decades was the chimes of Big Ben. Lord Reith, the founder of the BBC, said that he wanted "the clock which beats the time over the houses of Parliament, in the centre of the empire, [to be] heard echoing in the loneliest cottage in the land." Parliament-cottage, center-periphery, empire-village, urban-rural--the sound of Big Ben was to the British Empire what the local clock

tower was to a village, its pulse of common life. Bells, like fireworks, are public displays that collectively mark local space and time as festivals and holidays. They hail us as political or religious subjects. As Corbin (1998) argues, as bells were displaced by other systems of sound production and community media, the one meaning they retained was a sacral one--their sound is of deep time, death, and the echo of history.

A similar role is played in Muslim cities by muezzin (criers) who are now electrically amplified to sing the call to prayer five times per day. Their voices, broadcast from the thin minaret towers attached to mosques, summon the local populace (with limited success in my experience of cosmopolitan cities such as Cairo, Istanbul, and Jerusalem); the typical volume of amplification without strict clock coordination means that one can hear competing or contrapuntal muezzin over the city as if in a Muslim beehive. It is hard to know which voice to hearken to but there is no question about which religion saturates the air at that moment.

The culmination of electrically aided sound from artificial heights is of course the radio tower. Television broadcasting and cellular telephony likewise depend upon networks of towers, and perhaps satellites are the ultimate tower with their "footprint" of continental reach. Even the Eiffel Tower has an acoustic side as the "cradle of French broadcasting" (Braibant 1964). It was central to the conquest of the airwaves. In 1899 Marconi succeeded in sending a radio telegraph "wire" across the English channel from the Eiffel Tower. Airplanes guarding Paris during World War I were directed from it, and in 1915 it was the vehicle of transatlantic contact. In World War II, it was an important military target, enough for Adolf Hitler to pose sentimentally before it, a conqueror awed by the object of his conquest. Barthes rightly notes that the Eiffel Tower is a symbol, among other things, of communication--but it is also a channel of communication, its top still bristling with transmitting and intercepting devices.

Finally, towers are catastrophic places of danger, emergency, and death. They are the spots from which the news will come, and places at which gravity works most pitilessly. Clocks and calendars can provide intimations of mortality--sundials alert us to our fleeting hours and watches tick like death--but towers far outshine them in sheer awesomeness. In Hamlet--like Agamemnon, a play about adulterous parents and avenging children that opens with uncanny sightings atop a watchtower--Horatio warns Hamlet with an acrophobic description of the edge of the tower's platform:

> The very place puts toys of desperation,
> Without more motive, into every brain
> That looks so many fathoms to the sea
> And hears it roar beneath . . . (Hamlet, I.iv.75-78).

The Eiffel Tower, like its cousin the Golden Gate Bridge, is one of the world's premier destinations for suicides. With their "unearthly height" towers put the fear (or allure) of death into us all. Towers enable a rendezvous of the living and the dead. Like bells, they draw their sublimity from communicating between the mundane and the urgent. Towers stand between heaven and earth, height and expanse, the sacred and the secular and they are primal extensions of our eyes and ears. In the twenty-first century they have lost none of their ability to put "toys of desperation" into our brains or to anchor communication networks.

Logistical Media

Calendars, clocks, and towers are different in several ways, and towers are more different than the other two. But all three establish basic coordinates of time and space. They are all data-processors. They establish the central points about which culture rotates. They belong to a neglected category of media that are so fundamental that they rarely come into view. Logistical media arrange people and property into time and space. They stand alongside more obvious media that overcome time (recording) and space (transmission) and produce messages and texts. Logistical media do not necessarily have "content"--they are prior to and form the grid in which messages are sent. Calendars, clocks, and towers are not unique as logistical media--maps, names, addresses, archives, museums, census, stamps and seals, compasses, astrolabes, and the shofar are as well. So is money--perhaps the paradigm case. McLuhan's claim that the medium is the message is especially apt here. Logistical media establish the zero points of orientation, the convergence of the x and y axis. They often seem neutral and given--something which gives them extraordinary power.

Though logistical media such as calendars, clocks, and towers are ancient, their relevance is urgent thanks to new media such as Google--whose power owes precisely to its ability to colonize our desktops, indexes, calendars, maps, correspondence, attention, and habits. New media return us to old media. The fundamental problems that media face are both old and new: time, space, and power. Media record, transmit, and organize; they have memory, networks, and processors; embody the institutions of temple, market, and palace (Couch 1986); and fill the three main functions of recording, transmission, and logistics. As devices that organize space and time and orient us to the cosmos, media such as calendars, clocks, and towers are partners and competitors with religion as designers of both ultimate things and the texture of everyday life.[1]

[1] This essay adapts entries previously published as "Calendar" and "Clock" in Encyclopedia of Religion, Communication, and Media, ed. Daniel A. Stout (New York: Routledge, 2006), 57-59, 77-79. I am grateful to the publisher for kind permission to rework this earlier material.

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